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THE EFFECT OF MENTAL VISUAL IMAGERY INSTRUCTION ON THE READING COMPREHENSION OF FOURTH GRADE CHILDREN

by

© DOROTHY E. LLOYD

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled: The Effect of Mental Visual Imagery Instruction on the Reading Comprehension of Fourth Grade Children submitted by Dorothy E. Lloyd in partial fulfilment of the requirements for the degree of Master of Education.

Frances M. MacConnell
Supervisor

Wilma Laing

Sr. Therese Craig

Date September 25, 1981.

Dedicated to Bonnie-Jean

Who so generously and capably assisted

me in a time of "flack of need."

ABSTRACT

Reading comprehension is a complex process. Durkin (1978) questioned whether comprehension is, in fact, teachable when the results of her observations indicated that definitive techniques and procedures for the teaching of reading comprehension have not been established in instructional programs. The purpose of the study described in this report was to determine whether the reading comprehension of fourth grade children will improve after mental visual imagery instruction.

Fifty-two subjects (twenty-five boys and twenty-seven girls), selected from a heterogeneous population of one hundred thirty-seven students comprised the sample for the study. An experimental curriculum containing a mental visual imagery component was designed and presented to the twenty-six subjects randomly assigned to the experimental group. The twenty-six subjects randomly assigned to the control group were exposed to a curriculum which differed from the experimental curriculum only in that the mental visual imagery component was removed.

Pre-and post-test scores from the Standard Reading Inventory (McCracken) provided a measure of comprehension achievement. During each testing session the subject read two prose passages silently and after reading a passage was asked to orally recall the content. Recalls were tape recorded and transcribed for analysis in accordance with procedures described in the Comprehension Categories for Protocol Analysis (Fagan, in press) in an attempt to investigate the effect of mental visual imagery instruction on the comprehending processes.

The statistical analysis of the data included a one-way analysis of variance and covariance to determine the level of comprehension achievement. A two-way analysis of variance with repeated measures was used to

analyze the extent of information generated and differences in comprehending processes. Differences in decoding and comprehension skill group achievement were examined through a two-way analysis of variance for unequal numbers. The Tukey method of comparison was used to obtain levels of significance.

The results indicated a significant difference ($p < .05$) in reading comprehension after mental visual imagery instruction. As compared to the control group, experimental subjects generated more units of information in the immediate recall (significant at the .05 level) and remembered more of the information in a delayed unaided recall task (significant at the .01 level). No significant difference was reported in the mental processing of text information. However, an increase in synthesis and summarization was noted in the experimental group recalls of passage content. There was no significant difference in the achievement level of the decoding and comprehension skill groups.

The findings of the study suggest that mental visual imagery instruction significantly increased reading comprehension. Readers seemed to process and remember more information as a result of an increased ability to synthesize and summarize passage content after exposure to visual imagery instruction.

Suggestions for the incorporation of mental visual imagery into the reading comprehension instructional program and for further research were included in the report of the study.

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CHAPTER I

INTRODUCTION

The Problem

Comprehension is the very essence of reading. The title of Yetta Goodman's (1976) article, Reading Comprehension: A Redundant Phrase, exemplifies the agreement among the many reading experts who believe that the ultimate objective of reading is to enable the reader to understand what he reads and not just to verbalize words from a written page (e.g. Bormuth, 1969; Smith, 1971; Smith, 1977; Durkin, 1978). Although words may be said or sentences scanned visually, no reading has occurred until two persons, the author and the reader, communicate via the medium of print. This act of communication requires the reader to be actively involved in a meaning seeking process.

In the opinion of Tovey (1976), the meaning seeking process can not be taught by direct instruction but rather, stimulating situations can be provided for the reader which might induce and encourage the processing of print into meaning. Thus, it is motivation not instruction that induces reading comprehension. Tovey's assertion may be correct in so far as it pertains to meaning - the final product of comprehension. Meaning cannot overtly be taught for it requires, in combination with the author's input, an individual input on the part of the reader, not derivable from instruction but resulting from a composite of personal background experiences brought to the reading situation, through which interpretations of the message are made. Nontheless, the mental processing required before the meaningful product is attained is an equally important facet of reading comprehension.

Fagan (1981) differentiates between the process and product of meaningful reading by labelling the product comprehension and the process comprehending with the explanation, "As a product, comprehension occurs each step along the way in conjunction with the processes which contribute to it." (p. 1). If Tovey is correct and the product, comprehension, cannot be taught, then perhaps it is through the processing aspect, comprehending, that investigation will bring forth an answer to the question that Durkin (1978) posed: "Is reading comprehension teachable?" (p. 537). In other words, can instruction be provided to encourage and facilitate the development and refinement of mental processing strategies that aid in the comprehension of prose? If the question is to be answered in the affirmative, then the task confronting educators is to identify techniques which will provide the required assistance for the development and refinement of mental processing strategies and to devise clearly defined instructional methods for employing such techniques.

In the quest to identify techniques and instructional methods that will enable children to read in a natural and meaningful manner, it seems only logical that the most beneficial instruction would capitalize on strategies readily available to the reader as part of the innate mental functioning and attempt to develop these strengths to the fullest. Among the heuristics readily used by some readers is mental visual imagery (Anderson and Kulhavy, 1972). That is, the reader uses cues in the written discourse to form 'pictures in her head' of people, objects and events which according to MacCannell (1978), "may be an economical mode of storage to provide a search field upon which to draw for possible meaning of listening and reading content." (p. 15).

Gans (1940) defined reading as a "thought getting" process i.e. a complex organization of patterns of higher mental processes that embraces all types of thinking including imaging. Levin (1972) suggested the possibility that mental visual imagery is an organizational strategy which allows the reader to efficiently and independently reorganize relatively disorganized reading material. Smith and Johnson (1976) recommended instruction to "form mental pictures of situations or conditions that are described in a sentence or a longer passage" as a skill that will effect comprehension (p. 176). When advocating the improvement of reading comprehension through the promotion of creative writing, Maya (1979) suggested that before the teaching of writing begins, children need to develop skills in visual imagery, listening, and speaking. Steingart and Glock (1979) considered visual imagery to be a strategy that can be effectively taught as a prose learning technique. These opinions and suggestions typify the agreement among many reading experts that the development of a visual imaging strategy will enhance the reader's comprehension of prose.

Despite the concurrence among numerous educators and researchers as to the effectiveness of mental visual imagery as a technique for teaching reading comprehension, most investigators have tended to use lists of unrelated words (paired associate learning, e.g. Bower, 1972), or sentence by sentence presentation of passage material (Levin and Devine-Hawkins, 1974) or specially organized passages of highly concrete content (Steingart and Glock, 1979). It was the intent of this study to focus on material similar to that of prose texts typically read by children in the classroom in order to investigate the practical

applicability of mental visual imagery as an instructional technique designed to enhance reading comprehension.

Purpose and Methodology of the Study

The major purpose of this study was to investigate the effect of mental visual imagery instruction on the reading comprehension of fourth grade students. The testing passages were composed of material similar to that used in the daily reading programs of many classrooms in an attempt to approximate a more typical prose learning environment than had been provided in many of the previous visual imagery studies.

Unaided recalls were recorded and analyzed in an effort to determine whether distinctions could be made between the nature of the comprehension processes used prior to and following the imagery instruction. Immediate and delayed recalls were recorded and analyzed to compare the extent of information generated spontaneously and the degree to which the information was retained over time.

Decoding and comprehension scores taken from the Edmonton Public Schools Elementary Reading Test: Grade Three were used as a guideline to place students in one of four skill groups according to their combined proficiency in these skills. The groups were determined on the basis of performance in both skill areas yielding the following designations: adequate decoders/adequate comprehenders, adequate decoders/low comprehenders, low decoders/adequate comprehenders, low decoders/low comprehenders. Skill group means were compared in an effort to discover if there was a relationship between a skill group and level of achievement that is, if visual imagery instruction enhanced reading comprehension more so for one skill group as compared to the others.

Definition of Terms

The following terms were used in this study as defined below.

Mental Visual Imagery also synonomously referred to as visual imagery and imagery in this report.

"Non verbal modes of thought (e.g. imagination) in which representation of concrete objects or events are actively generated and manipulated by the individual." (Paivio, 1971).

Mental Visual Imagery Instruction also synonomously referred to as imagery instruction in this report.

The teacher does or says something with regard to mental visual imagery with the purpose of enabling students to understand the intended meaning of a prose passage.

Protocol

A subject's oral interpretation of a written passage.

Unaided Recall

The spontaneous retelling of a story without the aid of questions or prompting.

Comprehension Categories

A descriptive framework within which to analyze subject generated protocols. The categories are: text exact, text specific, text entailed, text experiential and text erroneous.

T-Unit

A t-unit consists of a main clause and any subordinate clauses attached to it. It may be a simple or complex sentence but not a compound sentence (Fagan, in press).

Incomplete T-Unit

A group of lexical items which lacks one of the components necessary to form a basic t-unit. A subject, verb, necessary object, complement, or any combination of the above may not be overtly present (Loban, 1976).

Partial T-Unit

The unit formed when a t-unit or an incomplete t-unit is divided because the original unit contained more than one element of information.

Skill Groups

Adequate Decoders/Adequate Comprehenders

Those subjects whose decoding and comprehension scores on the Edmonton Public Schools Elementary Reading Test: Grade Three were at or above the 50th percentile.

Adequate Decoders/Low Comprehenders

Those subjects whose decoding scores on the Edmonton Public Schools Elementary Reading Test: Grade Three were at or above the 50th percentile and comprehension scores were at or below the 45th percentile.

Low Decoders/Adequate Comprehenders

Those subjects whose decoding scores on the Edmonton Public Schools Elementary Reading Test: Grade Three were at or below the 45th percentile and comprehension scores were at or above the 50th percentile.

Low Decoders/Low Comprehenders

Those subjects whose decoding and comprehension scores on the Edmonton Public Schools Elementary Reading Test: Grade Three were at

or below the 45th percentile.

Hypotheses

The following null hypotheses were formulated and investigated.

Hypothesis 1

There will be no significant difference in the comprehension of prose by fourth grade readers after mental visual imagery instruction.

Hypothesis 2

There will be no significant difference in the total amount of relevant information generated in the unaided immediate recalls after mental visual imagery instruction.

Hypothesis 3

There will be no significant difference between groups in the amount of relevant information stored and retained over time:

(a) in the aided and unaided recall of information required in the achievement test

(b) in the total units of information recalled

Hypothesis 4

There will be no significant difference in the frequency of units which fall into each of the following comprehension categories after mental visual imagery instruction:

(a) text exact

(b) text specific

(c) text entailed

(d) text experiential

(e) text erroneous

Hypothesis 5

There will be no significant difference in the achievement of the following skill groups after mental visual imagery instruction:

(a) adequate decoders/adequate comprehenders

(b) adequate decoders/low comprehenders

(c) low decoders/adequate comprehenders

(d) low decoders/low comprehenders

Levels of significance for the rejection or non rejection of the hypotheses was set at $p < .05$ and $p < .01$.

Assumptions

The study was conducted with the following underlying assumptions.

Differences in subjects' experiential background, verbal fluency, and previous instruction which could have influenced the reading recalls were assumed to have been randomized across the groups.

The reading achievement scores obtained from the Edmonton Public Schools Elementary Reading Test: Grade Three administered in May 1980 were assumed to be an adequate indication of the subjects' reading ability in April 1981.

Use of the Standard Reading Inventory (McCracken) as an instrument of measuring comprehension assumes a similar reaction of Canadian children to that of American children when reading American materials.

The Comprehension Categories For Protocol Analysis developed by Fagan (in press) was assumed to have validity and reliability similar to that of his previous categories (Fagan, 1979).

Significance of the Study

The existent deficiency in the understanding of comprehension and its instruction is substantiated by the results of the Durkin (1978) report. Among the major findings in the investigation was the fact that almost no reading comprehension instruction occurred in the thirty-six participating classrooms. The study illustrates the serious lack of understanding about the teaching of reading comprehension that exists in the field of education today. To alleviate the problem, there is an urgent need for techniques and procedures, effective in the development of comprehension processes, to be explicated for use in the classroom. The results of this study may help to define a method of instruction that would develop strategies for comprehension, retention, and recall of prose information.

There is also a need for more information regarding the nature of comprehension and its constituent processes. Further insight as to the mental processes associated with the comprehension of prose may result from this investigation.

Limitations of the Study

The following limitations are noted.

The population included in the study as assigned by the Edmonton Public School Board was limited to one hundred thirty-seven grade four students from "normal" classrooms. Matching, random selection and assignment reduced this number to fifty-six. Subjects dropped from the study further reduced the sample to fifty-two. The findings of this investigation are applicable to this group.

The Canadian Cognitive Abilities Test scores were unavailable for eight subjects so scores of other tests and teachers' opinions were

considered when allowing the subjects to remain in the sample.

The very nature of mental visual imagery makes it difficult to establish its use or disuse with certainty. Subjects in the control group may have spontaneously used an imaging heuristic in the comprehension and recall of passage information.

The requirement of an oral recall, the presence of a tape recorder, and some minor interruptions during instruction and testing may have affected the performance of some subjects.

The limited amount of time allotted to mental visual imagery training may have affected the results of this study.

Plan of the Investigation

The investigation is reported according to the following plan.

In Chapter II a review of the literature relevant to the study is presented. Chapter III describes the experimental design. The findings are presented and discussed in Chapter IV. Chapter V presents a summary of the study, conclusions, implications of the findings and suggestions for further research.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

The theoretical framework upon which the study was based will be discussed in this chapter. An historical background to mental visual imagery is presented and followed by a review of the research concerned specifically with mental visual imagery and prose comprehension. Investigation concerned with the generation of information, its retention, and recall is reviewed. The chapter concludes with research findings that are related to the system used in this study for analyzing unaided recalls.

Historical Overview of Mental Visual Imagery

In the sixth century B.C., the Greek poet Simonides of Ceos recognized the value of mental visual imagery as a strategy for organizing and remembering ideas. He is said to have developed a technique in which the ideas to be remembered were systematically imaged in ordered locations such as the rooms of a familiar house (Paivio, 1970). The ideas could then be retrieved by mentally walking through the house and in doing so, each room image would bring to mind the idea image located there. Present day terminology would describe Simonides as using imagery as an associative mediator. That is, "When we image something, we tend to evoke an isomorphic relationship between the information presently available to us and information that we gathered from the stimulus event that we are trying to remember." (Fagan, 1980, p. 3). The following century, Plato formulated what could be considered a forerunner to the modern memory trace theory. His was a wax tablet model of memory which postulated that thoughts and perceptions will be remembered

and known as images imprinted in the mind in a manner similar to imprints made on a block of wax. The more vivid image was considered to yield a better memory trace and consequently, a more accurate recall (Yates, 1966). Huey (1908) investigated the role of imagery in meaningful reading. He argued that reading for meaning includes the arousal of images from sentence information. Fernald (1912) addressed the problems arising from trying to differentiate between types of mental imagery (e.g. visual, auditory, motor, and verbal), the cause of these differences, the function of imagery in memory and learning, and the influence of training in mental imaging strategies. Her comment, "The confusion and contradiction here indicated are characteristic of the present condition of the literature on imagery" (p. 15), reflects the difficulties that arise when the empirical world attempts to categorize and classify phenomena as illusive and individualistic as mental imagery. A review of the literature seventy years later suggests that much of the same confusion and contradiction continues to mystify researchers as to the nature and influence of mental imagery in memory and learning.

When behavioristic thought pervaded the psychological world in the first half of the twentieth century, imagery was discredited by behaviorists as being empirically unverifiable and unacceptably mentalistic. Previous to this revolution, psychology had been a science which studied the mind or consciousness through a method of introspection. Now, behavior replaced consciousness as the focus of study and the method of conditioning was substituted in place of introspection. Acknowledging this trend of thought, Paiget and Inhelder (1971) prefaced their book, Mental Imagery in the Child, with the following comment:

> Several colleagues have advised us to change it [the book's title] on the grounds that it might come under suspicion of 'mentalism,' and because many writers no longer believe in the existence of images.... But it must be said we care little about fashions in psychology. ... As it is our intention to make a study of memory in the child, we naturally had to begin by examining 'images' - even if it is fashionable to pass over the problem in silence. (p. xii).

As behavioristic psychology gradually released its grip on the theories of learning, imagery regained credibility and became a focus of attention among many researchers in the disciplines of psychology and education. According to Paivio (1970), objections to imagery research were no longer valid because behaviorists had accepted implicit verbal responses which, in his opinion, are just as inferential as mental images, "they are mental words which like images must be inferred from overt behavior and the stimulus situation in which it occurs." (p. 386).

Holt (1972), commenting on the resurgence of interest in imagery described it as a "long neglected topic just emerging from ostracism" (p. 10). He noted the passing of the 1950's with just one major publication (McKellar, 1957) on imagery but that numerous publications including periodical literature have appeared since 1969. The increase in imagery literature is attributed to a renewed interest in the subjective world and Holt responds to the often repeated charges of unscientific procedures in the investigation of the subjective world by declaring that the scientific method is an appropriate and necessary aid in analyzing the mental data yielded by introspection.

> It [science] does not demand that if a problem cannot be tackled with complete objectivity, one should sit with folded hands; the greatest scientists have always addressed important problems with the best tools available, while striving to make them even more precise and more adequate. (p. 5).

Holt, like Paivio, concluded that even behavior therapy for all its proclaimed objectivity makes extensive use of imagery in its methodology.

Research Related to Mental Visual Imagery and Prose Comprehension

While the bulk of mental visual imagery research has occurred in the field of psychology, an increasing body of literature has emerged as a result of educational research into imaging strategies utilized by students as they learn. Of particular interest has been the function and functioning of mental visual imagery in prose learning. Reese (1970), when discussing the combined results of three studies he had conducted, assumed the major influence of imagery to be its effect on memory in both the storage and retrieval of information. He suggested that visual imagery arouses meaning and facilitates retention of information through the integration of ideas in a contextual milieu. Rohwer (1970) reviewed a number of experiments pertaining to the role of imagery in children's learning and presented some educational implications of the research. He concurred with Reese's finding, isolating mental imagery as an important factor in children's learning, and cited imagery as a process whereby children represent and store information in the memory. To foster acquisition and retention of information, he recommended the presentation of material in a meaningful context rather than in isolation thus promoting the generation and storage of the more memorable active images rather than static images which are more readily forgotten.

Anderson and Kulhavy (1972), using high school students as subjects, asked them to form mental images while reading a two thousand word prose

passage. Following a post-test, subjects in both the experimental and control groups were questioned as to whether they used mental imagery in processing the text information. Although an analysis of the post-test variance did not show a significant effect for the imaging group, the questioning revealed that one third of the experimental group did not use imagery during the experiment but more than one half of the control group did. A statistical analysis of these reports related performance to imagery. From their data, Anderson and Kulhavy concluded that an imaging heuristic increases the learning derived from a prose passage. Because of their results, they recommended further research into instructional procedures that will elicit and maintain an imaging strategy.

Levin and Devine-Hawkins (1974) attempted to discover if visual imagery is a useful and effective organizational strategy in the comprehension and recall of prose information. Hypothesizing that visual imagery may interfere with the visual processing of print, they presented information in one of two modes, reading and listening, to forty-eight fourth graders in an attempt to determine if competing or antagonistic responses may be produced from visually processing the printed words while simultaneously visually imagining the passage's description. The investigators assumed that the verbal-auditory requirement of listening would be easier than the presumed dual visual processing requirement of reading. Their findings are interpreted as determining imagery instruction to be more effective in a listening than in a reading condition.

Following an elaborate training program which involved the production of cartoons by third and fourth grade students selected from

a multi-racial inner city school, Lesgold, McCormick, and Golinkoff (1975) noted an improvement in performance on a paraphrase recall task after the imagery instruction. During the instructional treatment, the subjects read stories and then illustrated the contents for twelve training sessions, each one lasting for twenty-five minutes. Pre- and post-tests using the Metropolitan Achievement Test and a paraphrase recall test were administered. The MET showed no significant differences between the groups after treatment. The researchers attributed this finding to the nature of the test for they perceived the MET to be sensitive to word recognition skills, isolated sentences and certain test taking skills but not skills to which visual imagery makes a contribution (e.g. skills involved in learning and using prose information). However, based on the results of the recall task, Lesgold et al. reported a positive relationship between imagery and organizational and storage skills. Two conclusions were drawn from the study: (1) effective imagery instruction requires that subjects be exposed to a training period of adequate length, (2) children must be reminded to use an imaging strategy each time they read. The investigators assumed from the study results that instruction in comprehension skills is possible and they recommended further research into the range of comprehension skills amenable to direct training.

Steingart and Glock (1979) found an imaging strategy used by college students to be more facilitative of comprehension of text relationships than a repetition strategy. Subjects in the imagery group were asked to form composite pictures in their minds of the objects described in prose passages containing highly concrete content. The repetition subjects were asked to read the same material but to

recite the passage paragraphs repeatedly to themselves during an allotted study time. Imagery subjects recalled significantly more text relationships than the repetition subjects. Steingart and Glock attributed some of the imagery group's achievement to an increase in inferential processing "due to the organizing of the text information into unitized figural representations whose elements tended to be retrieved together during recall." (p. 10). They considered it to be important to determine the generalizability of their findings to other populations and to other kinds of prose texts, particularly those typically read by children and adults. They suggested the usefulness of imagery in the teaching of reading, remediation, and in the improvement of reading comprehension.

That visual imagery may not be an effective or efficient learning strategy for all readers seems to be indicated by some of the research literature. Although some students spontaneously use an imaging heuristic (Anderson and Kulhavy, 1972), others, according to the findings of Riding and Taylor (1976), process prose so well verbally that providing them with imagery instruction may not improve their information processing strategies. These researchers hypothesized that children are either verbal or imaginal learners and the preferred mode of learning could be determined by the latency of a response to a question selected from the reading material. Subjects listened to passages similar to the following: "The little boy walked slowly up the cobbled path to an old cottage. When he reached the door, he paused and looked at it before knocking." (p. 94). The question was then posed: "What color was the door?" Imagers were expected to respond quickly with the color whereas, the verbalizers' responses would be delayed as they had not 'seen' the door. Based on this

assumption, thirty-three children between the ages of 7.0 and 7.5 years were assigned to one of three groups: high, medium, or low imagers. The subjects were tested for prose comprehension through questions pertaining to two passages, one having concrete content, the other having abstract content. Response time was measured from the end of the question to start of the response. A decrease in imagery performance was found to correspond with a decrease in the comprehension test score for a concrete passage but with an increase in comprehension for the abstract passage. From this evidence Riding and Taylor presumed the possibility of distinguishing between different cognitive styles (i.e. imaginal and verbal). However, this test measured only imagery performance while verbal coding is merely the inferred alternative method of coding.

Working with another type of learner, the educable mentally retarded, Bender and Levin (1978) reported a failure of imagery instruction to improve the comprehension of these children. After one practise session, ninety-six subjects whose mean ages were between twelve and fifteen years, listened to a story and were asked to answer twenty questions. The subjects in the imagery group were reminded to image during the story to ensure the application of the strategy. The imagery instruction did not improve recall of the story and Bender and Levin concluded that the "complex process of generating and regenerating images while keeping track of theme and events of a story is too great a requirement for EMR children." (p. 587).

Pressley (1977) reported that first grade school children were unable to use mental imagery to improve their memory retention of prose when instructed to do so but by eight years of age children had develop-

ed the ability to apply a visual imaging strategy to the complex task of prose learning. Dunham and Levin (1979) likewise, found imagery instruction not to be facilitative to the recall of story information by kindergarten children and first graders.

Paivio (1970) suggested the employment of imagery as a useful method of learning and remembering for people of all ages. "Its functional role probably being determined by the nature of the learning tasks and the subject's experience in dealing with them." (p. 391). He cited the supposition of Piaget and Inhelder (1971) that at about seven or eight years of age children develop the capacity of anticipatory imagery and he then compared Piaget's model with Bruner's postulation that at approximately age seven or eight the capacity for verbal symbolic modes of thought develop. Paivio concluded: "This may be the age at which the capacity for symbolic transformations - from words to images and back to words - makes a quantum leap." (p. 392).

The benefits accrued from mental imagery instruction by "difference poor" readers was viewed with optimism by Levin (1974, 1979). Difference poor readers were defined as those who have adequate decoding skills but are low in comprehension skills. According to Levin, the generation of images while reading may be an effective organizational strategy in fostering the comprehension of prose for these readers. The study comprised three groups: good readers, difference poor readers, and deficit poor readers (i.e. readers deficient in decoding and/or vocabulary skills). Short stories were printed on index cards - one sentence per card, and each subject was instructed to "think of a picture" in his mind of the sentence content as he read. After completing the passage the subject was asked to answer questions about the content. Imagery instruction facilitated the comprehension of the

good readers and the difference poor readers but not that of the deficit poor readers.

The implications of the literature are that a child must attain a certain level of mental development before visual imagery can become a heuristic in reading comprehension. Before the age of seven or eight years, a child seems unable to image effectively when reading: yet, as Piaget and inhelder (1971) suggested younger children may have an inherent capacity to image. Perhaps, it is not the stage of mental development of the child at age six or younger which negates the imaging strategy but rather a lack of knowledge on the part of educators regarding the nature and functioning of visual imagery in combination with inappropriate instructional techniques in its application that makes imaging seem ineffective at a young age. McKellar (1972) speculates as to likelihood of all people imaging just as all people probably dream. The imaging phenomenon may be overlooked or not noticed just as some people may not recall dreaming. The possibility of the underdevelopment of the imaging potential in readers of all ages is worth considering, particularly in view of the behavioristic era from which our culture has just emerged.

A further issue for debate arises from the literature as to the appropriateness of the training procedures used in many studies. For example, the imagery instructional programs of Levin and Devine-Hawkins (1974) and Bender and Levin (1978) seem to have consisted of asking children to form pictures in their minds of what was being read with very little practise afforded the subjects (Levin and Devine-Hawkins gave one practise sentence prior to testing; Bender and Levin gave three sentences to their subjects). Then the children were tested for their

ability to utilize visual imagery in reading comprehension and recall. The instructional method may have been an insufficient and inadequate training procedure upon which to base valid conclusions regarding the facilitative effects of an imaging strategy in reading comprehension and recall. Although Lesgold and his colleagues (1975) devised a more extensive training program, they expressed concern about its effectiveness because they neglected to clarify the purpose of the instruction. The subjects were not informed that the ability to image and produce cartoons could be transferred to the reading situation where imaging could help to promote comprehension and recall. For, as Lesgold et al. reported, "without such clarification, there is no evidence of uninstructed elaboration from one learning situation to another until about the eighth grade (p. 666). Therefore, the instructional program must clearly define for the student the purpose of the instruction before attempts at measuring effectiveness can be made.

A point should be raised concerning the use of imagery instruction as a method for the improvement of prose reading comprehension in the classroom. The research literature expresses the importance, here as in all educational instruction, of attending closely to individual differences and needs of those being instructed (Levin and Devine-Hawkins, 1974; Riding and Taylor, 1976; Levin, 1979; Steingart and Glock, 1979). Reading instruction in the past has been primarily directed toward the verbal mode therefore, in recommending the teaching of not only verbal but imaginal skills as well, Rohwer (1970) advised, "He [the student] should be equipped to transform information himself into a form that renders it maximally memorable. The development of such independent skill is surely worth the attention of those interested in the improvement of instruction." (p. 10).

Visual Imagery and the Generation, Retention, and Recall of Information

Sachs (1967) noted the tendency of readers to recall the meaning of a passage rather than the verbatim component. According to some researchers (Reese, 1970; Pavio, 1971), visual imagery facilitates comprehension by making text material more meaningful. Therefore, use of an imaging strategy when reading should produce a more extensive generation and recall of information than would otherwise be produced. The results of the Kulhavy and Swenson (1975) investigation lend support to this hypothesis. One hundred twenty-eight fifth and sixth grade students were instructed and tested in a large classroom at the participating school. Imagery subjects were asked to form mental pictures as they read while control subjects were merely asked to read the material. The recall test included verbatim and semantic items. Although the results were not significant, the imagery instructed pupils recalled somewhat more text information than did the control group. Visual imagery was described as an "efficient memory strategy," (p. 51) which aids in the recall of text information.

In response to the extensive training program of Lesgold, McCormick and Golinkoff (1975), Pressley (1976) devised a less involved instructional session using third grade children as subjects. A sentence was presented to imagery subjects with instructions to make "a picture in your head of the sentence" (p. 357). A slide picture depicting the meaning of the sentence was then shown to the subjects and they were to compare the elements of their image with that of the slide. Six training sentences and two short paragraphs were presented in this manner. After training, each child read a story composed of a series of concrete events. Subsequent to reading the story, each subject was given a book-

let containing twenty-four questions for which they were to write short answers. Summarizing the results, Pressley concluded that when eight year old children are provided with a mental imaging strategy but do not read and image at the same time, then recall of a highly concrete story can be improved.

The recall of objects in sentences was found by Purkel and Bornstein (1980) to be enhanced through use of visual imagery. Second grade children were instructed to "make a picture in your head of what is happening," (p. 154) while they listened to a story. During individual testing sessions, the subject was asked to answer orally a set of ten questions. Recall of story information immediately after reading was significantly better for the imagery group ($p<.01$). Subjects in the experimental and control groups who experienced a delay of one day between story presentation and testing demonstrated a significant decline in recall of information. The findings are said to "confirm the efficacy" of imagery as a prose learning technique and to indicate the influence of imagery in the memory processes of second grade students (p. 154).

When asked to use mental imagery to remember eighteen pairs of items, first and sixth grade children performed better than the control groups. In their study, Pressley and Levin (1980) found that reminding young children to use an imaging strategy at the testing session was beneficial. Imagery instructed students who were reminded to use an interactive imaging strategy remembered more information than those imagery students who were not asked to image at the time of testing.

The Levin and Pressley (1980) study is representative of the format adhered to in the majority of investigations into the effect of visual imagery on the retention and recall of information. Until recently,

visual imagery had been studied largely in terms of paired associate learning. That is, subjects are presented with pairs of unrelated items and asked to learn the pairs and remember then (e.g. words or pictures, Bower, 1972). Those studies deviating from the paired associage format tended to use testing material selected for its highly concrete, easily imaginable content (Lesgold et al., 1975; Pressley, 1976). In contrast, a purpose of the present study was to discover whether mental visual imagery increases the amount of relevant information generated by fourth grade students in a recall of reading material that is not specifically concrete but more typical of that in many classroom reading series. Concurrently, the effect of an imaging strategy on the retention and recall of that information was examined.

Analysis of Reading Comprehension Processes

The difficulty encountered when attempting to assess comprehension has in part been due to our deficient knowledge of the processes involved in comprehension and in determining which processes are used at a specific time. The most accurate and informative method of comprehension measurement presently available seems to be that of assessing the reader's paraphrase recall of a passage. Craik and Lockhart (1972) and Mistler-Lackman (1974) established the face and theoretical validity of using paraphrase recall as a method of gathering information to measure comprehension and the retention of information. Based on the paraphrase recall task, Drum and Lantaff (1977) devised a method of analyzing unaided recalls to assess eighth grade readers' comprehension of text. They describe able readers as those who remember the "gist" of what they read. Gist is defined as "the product of selecting and

rearranging elements of the text into a summary of elements of the content. The effectiveness of summaries are judged by some type of associative match between the text and recall." (p. 1). The instrument they developed for judging the gist of the free recalls consisted of five categories:

A. Text Specific - a unit corresponds with the text unambiguously.

B. Text Entailed - information is put together in new ways and additions of text related information that is semantically related by the text are included.

C. Text Elicited - text information is used but is combined in confused or erroneous ways.

D. Text Evoked - elements of the text are included but they are so general they do not convey any information.

E. Text External - units of information have no relationship to the text or they are repetitions of previously recalled statements. (p. 6)

Drum and Lantaff divided the paraphrase protocols into propositions and analyzed them chronologically. The better readers were found to have retained more text specific and text entailed information and recalled less text elicited and text evoked units. Prior experience was thought to contribute to differences in achievement groups.

Furniss (1978) studied the unaided recalls of proficient sixth grade readers through an adaptation of the Drum and Lantaff scoring categories. In this investigation four categories of comprehension were delineated: text specific, text entailed, text evoked, and text external. The result indicated that the subjects recalled more text evoked and text external information.

In conducting her comparative study of fourth grade high and low readers, Zinn (1979) used Furniss' system for analyzing unaided recalls. After presentation of passages with and without connectives, high

readers were discovered to have produced more text specific information than the low group and the low group produced more text evoked information than the better readers. Zinn concluded that logical connectives have an influence on the processes involved in comprehension.

When comparing the oral and silent reading of low and high achievers, Brake (1981) used Fagan's (1979) adaptation of Drum and Lantaff's protocol analysis categories. No difference was found in the nature of the information recalled by high and low achievers when reading materials were presented at the reader's instructional level. Although silent reading passages produced more text erroneous information than oral reading passages, the comprehension achievement of both good and poor readers was found to be superior in the silent mode.

Fagan (in press) offered a revision of earlier (1979) Comprehension Categories for Protocol Analysis. He recommended the analysis of propositional units in terms of the five categories as defined in the following table.

TABLE 1.1

Comprehension Categories for Protocol Analysis

A. Text Exact - information from the text in its exact form or with minimal variation is recalled.

   (A 1) verbatim recall
   (A 2) partial recall

B. Text Specific - information recalled has specific reference in the text. Some information may be transformed by reordering or substituting lexical items.

   (B 1) substitution of pronouns
   (B 2) synonomy of elements

C. Text Entailed - the information retrieved is (a) synonymous with the information input, but the unit of recall includes information from more than one unit of input or (b) a superordinate statement subsuming information from more than one text unit.

(C 1) synthesis
(C 2) summary

D. Text Experiential - information is added by the reader to fill in gaps in the text data. The reader is reconstructing information based on prior knowledge.

(D 1) inference
(D 2) case related information
(D 3) experiential intrusions
(D 4) storyline additions

E. Text Erroneous - the reader has produced the information incorrectly either at the time of comprehending or at production of the recall.

(E 1) errors in dates or proper names
(E 2) erroneous expansion/additions
(E 3) inaccurate/incorrect synthesis
(E 4) inaccurate/incorrect summary
(E 5) faulty inference

These categories were used to analyze the unaided recalls and determine the nature of the comprehension processes utilized by the readers in this study. See Appendix A for further elaboration of the comprehension categories.

Summary

For nearly two thousand years man has demonstrated an interest in mental visual imagery. Philosophers, psychologists, and educators continue to investigate this phenomenon in order to determine its role in learning and memory. More recently, interest developed as to the effect of visual imagery on the comprehension of prose by school children. The findings of the research seem to delineate imagery as an organizational strategy that integrates information so as to facilitate meaning-

ful interpretation, retention, and recall of passage information. According to some researchers, visual imagery may not enhance prose learning for all readers. Therefore, as with all modes of instruction, care must be taken to attend to individual differences when visual imagery is included in an instructional program designed to improve comprehension.

A system of analyzing unaided recalls in terms of processing categories appears to be useful in determining the nature of mental processes used by readers in the comprehension of prose. Such a system was used in this study. The design of the study is presented in the next chapter.

CHAPTER III

THE DESIGN OF THE STUDY

This chapter describes the experimental design, the experimental and control curricula, the selection of the sample, the selection, administration and scoring of the testing instruments, procedures, purposes of the pilot study, and the coding, analysis and reliability of the data.

Areas of Investigation Accounted For in the Design

This study was designed primarily to investigate the effects of mental visual imagery instruction on the reading comprehension of fourth grade students. As well, data were gathered and assessed to determine:

1. the total amount of relevant information generated in the recall protocols;
2. the amount of information that was retained over time;
3. the nature of the comprehension processes used by subjects as they read and interpreted the test passages;
4. the comparative achievement of subjects of varying decoding and comprehension abilities.

The Experimental Design

The experimental design of this study was similar to one of the three true experimental designs described by Campbell and Stanley (1963). The label, Design 4, has been applied to the design and the authors displayed it graphically in this form:

$$R\ O_1\ X\ O_3$$

$$R\ O_2\ \ \ O_4$$

The symbol R indicates the random assignment of subjects to groups. O_1 and O_2 refer to the initial observations of the experimental and control groups respectively which in this study took the form of a pretest. X represents the exposure of the experimental group to the treatment (imagery instruction). O_3 and O_4 signify post-testing of the two groups. Campbell and Stanley pointed out that the design is oversimplified in that it is presented as though treatment was being compared with no treatment when in fact the control group has been exposed to activities which fill a time period corresponding to the instructional time allotted to the experimental group (p. 183). In this study, instructional exposure was controlled in as much as instruction for both groups was identical except for the addition of the mental visual imagery feature in the experimental treatment. Therefore, the actual design of this study was:

$$R\ O_1\ X_E\ O_3\ O_5$$

$$R\ O_2\ X_C\ O_4\ O_6$$

X_E and X_C represent the respective instructional sessions of the experimental and control groups. O_5 and O_6 were added to the basic design in the form of a delayed recall.

The Experimental Curriculum

To control for internal variables, the curriculum was designed so that the visual imagery feature could be inserted into or removed from the lesson plans without disturbing the remaining content of the lesson. In this way an attempt was made to ensure that the experimental and control groups encountered the same instructional experiences (with the exception of the visual imagery component) when participating in the study.

The purpose of the instruction was carefully explained at the beginning of the first lesson. The subjects were informed they were going to practise a technique (i.e. visual imagery) that would help them to better understand and remember what they read. The clarification was intended to ensure that the use of imagery would transfer from the instructional to the testing session (Rohwer and Bean, 1973). The purpose of the treatment was reviewed at the beginning of the second lesson. At the conclusion of both lessons, subjects were reminded to use the technique, in school and otherwise, whenever they read. As well, at the end of the second lesson subjects were urged to use visual imagery in the post-testing session (i.e. "When Mrs. Lloyd [that is, the investigator] comes back to ask you to read stories for her again"). Before commencing the post-test the examiner asked each subject to take a minute to think about the technique presented in the treatment and then to use it during the testing (Pressley and Levin, 1980). Discussion of the strategy was disallowed so that the examiner remained unaware as to the group placement of the subject and thus avoided possible bias in test administration and scoring.

The initial information to be imaged was presented verbally. Because time constraints necessitated the development of an imaging strategy as quickly and efficaciously as possible, consideration was given to the Levin and Devine-Hawkins (1974) suggestion that an imaging strategy may be more readily elicited in a listening than a reading task. Therefore, subjects were asked to listen to short segments of a story read by the instructor and to form images while listening and then to discuss their images.

Emphasis was placed on the generation of active and interactive images rather than on attention to detail (Lesgold et al., 1974). Through questioning, subjects were encouraged to describe how events occurred, what was happening, and why it was happening, in order to promote the generation of active memorable images as opposed to the more easily forgotten static images (Rohwer, 1970).

During the first lesson, subjects listened to an adaptation of a story entitled, The Great Feast, written in the Childcraft Annual 1980 (see Appendix B). To aid in the development of an effective imaging strategy, the story contained concrete, highly imaginable, content (Paivio, 1970). Abstract concepts were also presented in the story to provide opportunities for inferential processing through a synthesis of story information and background knowledge (Steingart and Glock, 1979). The main objective of the imagery lessons was to nurture the formation and discussion of active and interactive images.

Levin (1973) found that subjects with adequate vocabulary skills benefitted from imagery instruction whereas those with inadequate vocabulary skills did not. Based on information compiled in the pilot test, a decision was made to insert five words from the testing passages into the lesson story. For purposes of this investigation, conceptual elaboration was provided for the words: drainage, pack horse, lack, and salt, as they seemed to cause unnecessary confusion and uncertainty for the pilot subjects. Thus, the opportunity for exposure to discussion of the concepts, in a context other than that used in the testing passages was made available to the subjects. Vocabulary deficits were not of interest in this study.

The story was presented in eight segments with discussion following each segment so as to provide a maximum amount of imagery training directly relevant to the task (Pressley, 1976). A minimum of two descriptions of interactive images were given by each subject during the lesson although all children were encouraged to share as many images as circumstances allowed.

The story used in the second lesson was taken from the third reader level of the Standard Reading Inventory (McCracken), (see Appendix B). Story content was less concrete and imaginable than that of the story in the first lesson. It was more similar in form and style to the content of the testing passages.

Subjects were asked to image as they read silently in the second lesson. According to the findings of Brake (1981) both low and high achievers comprehend material better when reading silently than when reading orally. Smith and Johnson (1976) claim "the proof of the pudding in most reading activities lies in the ability to communicate with an author while reading silently rather than orally." (p. 198).

These deviations from lesson one (story content and style and silent reading rather than listening) were implemented so that lesson two would more closely resemble the testing situation and in doing so, promote the transfer of the imaging strategy from the instructional task to the paraphrase recall task (Lesgold, et al., 1975).

Subjects were instructed to draw cartoons of their images after reading the story. Each child was encouraged by the instructor to explain his cartoons through descriptions of active and interactive images. The cartooning provided an opportunity of self expression for those subjects who may have been more adept at a graphic as compared to a verbal form of illustrating their images. It also allowed for a

confirmation of the subjects' abilities to image (Purkel and Bornstein, 1980). Through cartooning, all children indicated an ability to image what had happened in the story. The cartoon drawing activity also provided a quiet exercise for those subjects who more quickly read the story than others. Slower readers were, therefore, allowed time to read and form images without interruption. (See Appendix C for lesson plans).

The Control Curriculum

With the exception of the visual imagery feature, the control curriculum was identical to the experimental curriculum. The purpose of the instruction was carefully explained to the control subjects. They were told they would better understand and remember what they read through the method of concentration whereas the experimental group were told that understanding and remembering would come through concentration on forming a mental image. The same materials, activities, procedures, and instruction were used with both groups. The control group was reminded to practise their reading strategy in and outside of the classroom and during post-testing. The sole difference in instructional experiences for the groups was that the control group was asked to "concentrate" in order to improve comprehension and the experimental group was asked to "concentrate on forming a mental picture" to improve reading comprehension. (See Appendix C for lesson plans).

The Selection of the Sample

The sample for this study was selected from two schools within the Edmonton Public School System using three classes from both schools. From an initial population of one hundred thirty-seven grade four students, the following factors were considered in selecting a sample for the

investigation:

1. English as a second language: nine subjects were eliminated from the population because English was not their mother tongue. They were experiencing difficulty with oral expression and their reading decoding and comprehension skills were deemed by their respective teachers to make them inappropriate subjects for the study.

2. Pilot study: six subjects were dropped from the population because they were exposed to instructional methods and the instrument of evaluation during the pilot study.

3. Classroom teachers were consulted with regard to possible serious deficiencies (e.g. academic, social, or emotional) that might interfere with a student's participation in the study. No students were eliminated from the study due to these factors.

4. In an attempt to ensure that the experimental and control groups were derived from the same population, each subject's age and performance on intelligence and reading achievement tests were recorded for analysis.

As the results of the Canadian Cognitive Abilities Test (Thorndike et al., 1977) were available for the majority of subjects as a measure of intelligence, the score for this test was recorded. However, instruments other than the Canadian Cognitive Abilities Test had been used to obtain a measure of intelligence for twenty-six students in the population so scores were not recorded for these students as those available were of a different calculation from those of the Canadian

Cognitive Abilities Test. Rather than delete the twenty-six possible subjects from the study, a decision was made by the investigator to include them in the population from which a sample would be selected. The decision was based on the available IQ scores and teacher's opinions that the subjects in question were of approximately average ability. Eight of these subjects were selected to participate in the study.

5. Because a balance between the number of males and females was desired, twenty-eight girls and twenty-eight boys were selected to participate in the study. From a population of fifty-seven girls and sixty-five boys, the subjects were randomly selected and assigned to either the experimental group or the control group. Four subjects (three boys and one girl) were dropped from the study at various stages of the investigation due to inattendance at an instructional or testing session.

Testing Instruments

Results from three tests were used in study: the Canadian Cognitive Abilities Test (1977) Revised Edition, Form 1, Levels A-F, Grades Three to Nine; The Edmonton Public Schools Elementary Reading Test: Grade Three (1979); and the Standard Reading Inventory (McCracken, 1966), Forms A and B, Reader Four Level.

Intellectual performance was measured by the Canadian Cognitive Abilities Test (1977) Revised Edition, Form 1, Level A. The test was standardized in 1973. Norms were established using a stratified random sample of Canadian schools in which English was the language of instruction. The test consists of three batteries: verbal, quantitative, and

nonverbal. The nonverbal battery score was used in the selection of the sample to ensure that the IQ score did not reflect reading difficulties since the verbal battery requires the student to read. The test was used as a control to determine that differences between groups were not attributable to differences in intellectual ability (see Tables 2.1 and 2.2 in Appendix D).

A measure of each subject's reading achievement was obtained from the results of the Edmonton Public Schools Elementary Reading Test: Grade Three (1979) which were recorded in the student cumulative record files at each school. Materials used in the construction of this test came from three sources: the Houghton Mifflin Company; the Ontario Institute for Studies in Education; and the Edmonton Public School District. Using the Kuder-Richardson 20 reliability formula, the reliability coefficient for this test at a grade three level is 0.932. Experts within the Edmonton Public School District judged the content of the test to be valid. The Edmonton Public Schools Elementary Reading Test: Grade Three assessed four specific decoding skills and four specific comprehension skills. Final results for each student were presented as separate percentile rankings - one indicating decoding achievement, and one indicating comprehension achievement. These results were also used to establish that members of the experimental and control groups were selected from the same parent population (see Appendix D).

T-tests for independent means were applied to the data collected from the Canadian Cognitive Abilities Test and the Edmonton Public Schools Elementary Reading Test: Grade Three. To statistically assure that achievement differences between groups were not due to intellectual ability or level of reading skills, a t-test was also used to determine

whether there was a significant difference between groups in the chronological ages of the subjects. No significant differences were found between groups in intellectual ability, reading skills or age level (see Appendix E).

Steingart and Glock (1979) in their study, Imagery and the Recall of Connected Discourse, recommended that mental visual imagery research using prose texts that are typical of those read by school children be conducted. In response to this recommendation, the Standard Reading Inventory (McCracken, 1966), a testing instrument that approximates typical basal reading passages was selected as the medium of evaluation in this study. Forms A and B were used to obtain a comparative measure of comprehension achievement and to provide information regarding the nature of the strategies used by the subject when processing written information.

The Standard Reading Inventory (McCracken) was based on the content of three basal reading series: The Sheldon Basic Readers, Allyn and Bacon Inc.; The Ginn Basic Readers, Ginn and Company; and The Curriculum Foundation Series, Scott-Foresman and Company. Content validity for Forms A and B was confirmed through field research, evaluation by twenty-three nationally recognized reading experts, and two concurrent validity studies in which the Standard Reading Inventory and California Instructional Reading levels correlated 0.87 and the Standard Reading Inventory and Stanford Achievement Tests correlation for instructional reading level was 0.77 and 0.88 between vocabulary measures.

Administration of the Test Instruments

Passages were selected at the fourth reader level of Form A for the pre-test and from Form B for the post-test (see Appendix F). Pre-test instructions to each subject were as follows:

> I have two short stories I'd like you to read silently to yourself. When you finish reading the first story please tell me what you have read. You may take as much time as you need to read each story. If you cannot read a word, you may ask what it is and I'll help you. When you have finished telling me all you know about the first story then you will read the second story. Do you have any questions? The first story is about an orphan beaver. Do you know what an orphan is? (no parents).
>
> The second story is about the Wright brothers. Do you know what the Wright brothers did? (invent the airplane).

Post-test instructions were similar to those of the pre-test:

> Do you remember the last time I was here that you read stories and then told them to me? Well, again I have two short stories I'd like you to read silently, to yourself. ...Do you have any questions? The first story is called Turtle Eggs and one of the words in it is inhabitants. Do you know what inhabitants are? (people or animals that live in a certain place). Now please take a moment and think about the instructions Mrs. Hendrickson gave you when she worked with you and be sure to do what she taught you to do when you read the stories.
>
> The second story is about Daniel Boone. Do you know who he was? (a pioneer). Remember to do as Mrs. Hendrickson instructed you to do when you read the story.

As prescribed in the instructions in the manual, a story was preceded by a brief warm-up discussion but without reference to the specific content. Following each unaided response the subject was asked to answer any of the ten standardized questions included in the test that remained unanswered in the free recall (see Appendix F).

Subjects were tested individually in one of two rooms - a counselling room or a portable classroom. Both rooms were isolated and quiet with the exception of a few interruptions due to announce-

ments through the schools' inter-communication systems. All testing sessions were tape recorded. Pre-testing passages from the Standard Reading Inventory (McCracken) Form A, reader level four were administered on April 14, 15 and 21, 1981. Form B, reader level four, of the Standard Reading Inventory (McCracken) was administered as a post-test between April 29, 1981 and May 3, 1981. Delayed recalls, taken as a measure of retention of information over time, were recorded on May 6 and 7, 1981. Delayed recall instructions were as follows:

> Do you remember when I was here last week you read and then told me a story called Turtle Eggs? Please take a moment and think about the story and what Mrs. Hendrickson told you to do to help you remember stories. Then would you tell me all that you can remember about the story.

The same instructions were given for the second passage. As in the post-testing procedure, subjects were questioned to elicit answers to any of the questions that remained unanswered in the unaided recall.

The Canadian Cognitive Abilities Test and the Edmonton Public Schools Elementary Reading Test were administered as group tests by classroom teachers in 1980. For purposes of this study the test scores were considered to indicate probable levels of achievement and were used as measures of comparison.

Scoring of the Test Instruments

The ten standardized questions provided in the examiner's manual were used by the investigator as a guide to the scoring of the Standard Reading Inventory (McCracken). After reading each passage, the subject was asked to freely recall the story. Upon completion of the unaided recall, the subject was asked those questions which were incorrectly answered or unanswered during the free recall. Correct responses were

recorded by placing a plus sign in front of the appropriate question. A final score for each subject comprised a total of free and elicited responses to both stories read during the testing session. Identical scoring procedures were followed for pre-tests, post-tests, and the delayed recalls.

Procedures

The investigator met with principals and grade four teachers in the two participating schools to explain the study and its purpose. The teachers agreed to discuss the project and procedures with their respective classes without mentioning the content of the study. A note was sent home with each student to inform the parents of the study and to solicit permission for participation by the student. Following a pilot study, subjects were selected and assigned to one of two groups (i.e. experimental or control). All subjects were pre-tested individually by the investigator and recalls were tape recorded for later transcription.

Throughout the study the investigator remained unaware as to which group (experimental or control) a particular subject had been assigned as the instructional component of the study was conducted by the same independent teacher. As well as allowing the investigator to remain nescient as to which group a subject belonged, the measure of having one teacher conduct all instructional sessions was taken in an attempt to control the teacher variable. In this way all subjects were exposed to the same personality instructional style, and presentation of material in the lessons. The well qualified teacher held two degrees, a Bachelor of Education (English major) as well as a Bachelor of Fine Arts and had several years experience teaching language arts in the elementary grades

(two through six). Lesson content and procedures presented in this study were thoroughly rehearsed by the instructor before the instructional sessions commenced.

Eight groups of subjects comprised of not more than seven children each received two instructional lessons of thirty minutes duration. Each group attended one instructional session in the morning and one in the afternoon with a one day interval between lessons.

Post-testing followed a procedure identical to that of the pre-testing except that Form B of the Standard Reading Inventory (McCracken) was used. One week from the day of post-testing, a delayed recall was taken from each subject.

Purpose of the Pilot Study

The purposes of the pilot study were:

1. to assess the clarity and completeness of the lesson and testing instructions;
2. to assess the appropriateness of the lesson material and procedures;
3. to determine the subjects' abilities to produce mental images with little training;
4. to obtain an indication of the amount of time required for an imagery lesson and to determine the pacing of the lesson; and
5. to obtain an indication of the amount of time required for individual testing.

Six subjects (three boys and three girls) randomly selected from three classrooms participated in the pilot study. Two subjects were randomly assigned to the control group and the remaining four comprised

the experimental group. A pre-test, one instructional session and post-test provided the information required to consolidate the design of the study and the experimental curriculum.

Coding of the Data

Lesgold, McCormick, and Golinkoff (1975) suggested that direct instruction of comprehension skills is possible and that further study should be directed toward better understanding the range of comprehension skills amenable to direct training. The Comprehension Categories for Protocol Analysis (Fagan, in press) were used to examine the nature of the comprehension strategies used by the subject in the study in response to this suggestion.

Although there is general agreement among educators that the goal of reading is comprehension, it has proven to be a most difficult aspect of reading to be taught or assessed. It may be that this is attributable to the dual nature of comprehension for it can be viewed as both a process and a product (Fagan, in press). This study attempted to measure both aspects: the product with the Standard Reading Inventory (McCracken) and the processes with the Comprehension Categories for Protocol Analysis.

Fagan suggested four steps to be followed in the coding of the data when using his comprehension categories:

1. A. Four types of mazes were removed from the recalls
   (a) audible noise: un, er, ah, etc.
   (b) interjection: let me see, think, wait a minute, etc.
   (c) repetition: at first there's an orphan beaver and he was an orphan
   (d) correction: she takes a long journey no, I mean a short journey.

B. Recall conventions were deleted from the recall:

(a) they knew how to hunt, and shoot and every-thing.

(b) they had food and stuff.

2. A. Using the Comprehension Categories for Protocol Analysis as a guide, the transcribed unaided recalls were divided into basic t-units and incomplete t-units because they allow the scorer to readily judge whether or not a summary or synthesis of information has occurred in the recall (Fagan, in press). Separating protocols into smaller units (e.g. partial t-units is likely to have an adverse effect on the proportion of summary information offered in the protocol and thus, seriously restrict category C - Text Entailed - in the analysis. This category requires that information from two or more units in the passage be synthesized or summarized into one unit of information (see Appendix G). As it is difficult to provide a synthesis or summary in a unit smaller than an incomplete t-unit, it was the smallest unit used in this portion of the data analysis. Examples of t-unit analysis are:

Basic T-unit - "The story's about a turtle that lives down in a pond." (Subject #241)

Incomplete T-unit - She dug a hole about five inches deep and laid her eggs and returned to their home." (Subject #242)

Partial T-unit - "The turtle eggs look like little, round marbles, white ones." (Subject #130)

3. A. Based on the work of Drum and Lantaff (1977), Fagan has delineated five comprehension categories which were intended to describe the nature of the processes involved in comprehension. Inherent in the categorization is an attempt to differentiate between literal and inferential comprehension. Table 1.1 provides a summary of the categories. Each t-unit was placed into one of the five comprehension categories according to the information offered in the unit (see Appendix G).

   Because basic t-units and incomplete t-units may contain more than one unit of information, recalls were divided into partial t-units when they were analyzed for the total units of information generated and recalled (see Appendix H).

4. A. To assure the reliability of the above analysis by the investigator, an independent judge also analyzed the recalls of twenty subjects for the number of t-units and recall categories. Interrated agreement was calculated by using the Arrington Formula as outlined by Feifel and Lorge (1950). In this calculation, the number of scores agreed upon by each observer is doubled and then divided by the total plus the disagreements.

$$\frac{2 \times \text{Agreements}}{(2 \times \text{Agreements}) + \text{Disagreements}}$$

   The resulting agreement between investigator and independent judge was 0.96 for the t-units and 0.93 for the recall categories.

In addition to coding the data for comprehension processing, subjects in this study were also coded or categorized according to decoding and comprehension skill level. Using the skill categories of Levin (1973) as a guide, subjects were classified as to their comprehension and decoding abilities and grouped accordingly (see definition of terms). Group means were subjected to a two-way analysis of variance for unequal number to investigate the possibility of one or more groups benefitting significantly more than the others from visual imagery instruction.

Analysis of the Data

A one-way analysis of variance and covariance (ANCV15) produced the means for the comparison of achievement between groups. A two-way analysis of variance with repeated measure was used to determine if there was a difference in group means for total units of information generated and recalled, information retained in the delayed recall and in the comprehension categories. Levels of significance were obtained through the Tukey method of comparison. A two-way analysis of variance for unequal numbers was applied to the skill group data. T-tests for independent means were used to determine whether there were significant differences between group characteristics (i.e. IQ, decoding and comprehension ability, and age).

Summary

Fifty-two fourth grade readers (25 boys and 27 girls) provided the sample for this study. The independent variables IQ, age, decoding and comprehension achievement scores were analyzed to ensure that members of both groups were selected from the same population. Passages from the Standard Reading Inventory (McCracken, 1966) were administered

to each subject in pre-and post-testing sessions. A delayed recall was taken to measure the retention of information. Each subject received two, thirty minute instructional lessons presented, in all cases, by the same instructor. The sample was divided into two groups of equal number: an experimental group and a control group. Both groups received similar instruction but the experimental group lessons contained a mental visual imagery component that was not included in the lessons of the control group. Protocols were tape recorded and transcribed for analysis with the Comprehension Categories for Protocol Analysis. Statistical analyses of the data involved a one-way analysis of variance and covariance, an analysis of variance with repeated measures and an analysis of variance for unequal numbers. The Tukey method of comparison was used to analyze means. A t-test for independent means was used to determine whether there were significant differences between groups.

CHAPTER IV

RESULTS OF THE STUDY

This chapter contains the results in relation to the hypotheses and is organized in the following manner. An introductory statement is made then each hypothesis is restated from Chapter I and a statement of rejection or non-rejection is given. A table is presented illustrating the data upon which the hypothesis was or was not rejected. Each finding is discussed and further explanatory tables and figures as required are provided. The chapter concludes with a summary statement.

Visual Imagery and Comprehension Achievement

To date the research literature does not indicate a consensus regarding the effect of visual imagery on prose comprehension. Majhoor (1979), when investigating the effects of imagery instruction on the prose learning of adolescents, found that students who were exposed to the instruction performed significantly better than students who were not exposed to imagery instruction. Yet, Levin (1980) reported a study by Triplett (1980) which showed no facilitative effects of imagery when fourth grade students "who had received considerable practise at generating images" read prose passages." (p. 8).

In view of these contradictory reports, the major question addressed in this study was whether or not mental visual imagery instruction increases a fourth grade reader's comprehension of prose text. The subjects were pre-tested, exposed to treatment, and post-tested in an attempt to find an answer to this question.

The following hypothesis was formulated to determine the effect of visual imagery instruction on the comprehension of prose by the experi-

mental subjects.

Hypothesis 1

There will be no significant difference in the comprehension of prose by fourth grade readers after mental visual imagery instruction.

This hypothesis was rejected.

The analysis of variance and covariance applied to the achievement scores of the fourth grade readers (see Table 4.1 in Appendix I) indicated a significant difference in achievement between pre-and post-test means at the .05 level of confidence.

After an adjustment of pre-test means to determine the source of the significant difference, post-test means were compared and the resulting adjusted group means for achievement level indicates a significant difference in the post-test performance of the experimental group at the .05 level of significance (see Table 4.2).

TABLE 4.2

Adjusted Cell Means of Post-Test Comprehension Achievement of the Experimental and Control Subjects on the Standard Reading Inventory (McCracken)

Group	Post-Test Mean
Experimental	7.865[1]
Control	5.952

[1]Significant at .05 level ($p < .05$).

A comparison of unadjusted mean scores shows an average gain-score of 3.77 for the imagery instructed subjects in contrast to a gain-score of 0.77 for the control group. This gain in achievement is graphically

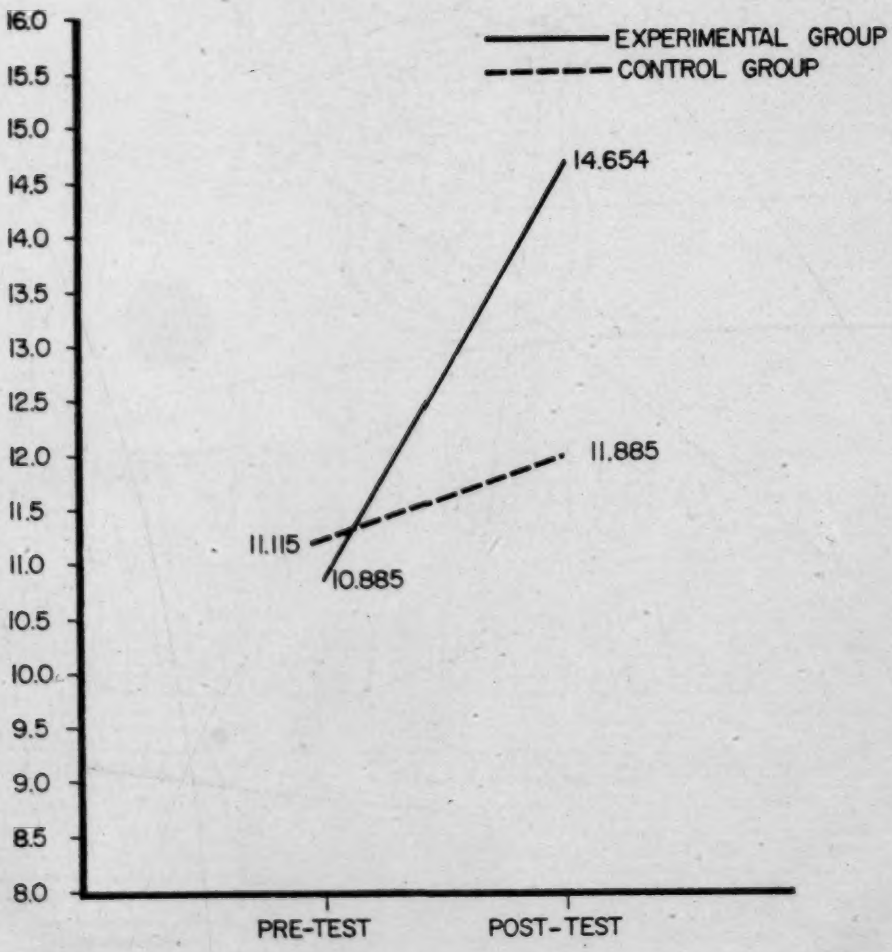

FIGURE 1

Unadjusted Cell Means for Pre- and Post-Test Comprehension Achievement of the Experimental and Control Subjects on the Standard Reading Inventory (McCracken)

illustrated in Figure 1.

Discussion

The finding of increased achievement in this study substantiates the contentions of Gray (1960), Smith and Johnson (1976), and Durkin (1978) regarding the value of imagery instruction in the teaching of reading comprehension. The result is also in agreement with the results of previous studies which demonstrated the positive effect of a mental visual imagery technique on the comprehension of prose (e.g. Lesgold et al., 1975; Kulhavy and Swenson, 1975; Majoor, 1979). In cautioning against generalizing their findings to the use of materials other than purposefully organized, highly concrete passages, Steingart and Glock (1979) called for studies using prose passages that would be typical of those read by children in order to determine if mental visual imagery would increase comprehension when that type of material is used. The result of the present study seems to provide a basis for generalizing the finding of Steingart and Glock to some classroom prose texts.

As in many other investigations finding imagery instruction to be facilitative of comprehension (e.g. Pressley, 1976; Guttman et al., 1977; Bender, 1979; Levin, 1979) the results in this study show an approximate ten percent gain in achievement for the experimental group as compared to the control group. Levin (1979) argues that ten percent is a disappointingly small gain, and comments, "because of this some of my initial enthusiasm directed toward visual imagery as an effective - and teachable - prose learning strategy (e.g. Levin, 1972) must surely be dampened." (p. 19). Many of the studies upon which Levin based his opinion (e.g. Levin and Devine-Hawkins, 1979; Kulhavy and Swenson, 1975; Lesgold, McCormick and Golinkoff, 1975) contained either achnowledged weaknesses in the design as in the Lesgold et al. study (p. 666) or included a

minimal amount of instruction. Similarly, the presently reported investigation included just two visual imagery instructional sessions, yet the treatment appears to have increased reading comprehension approximately ten percent which, in this study proved to be a significant gain. Perhaps, the insertion of a visual imagery component into the regular reading comprehension instructional program would, over time, increase comprehension substantially more than the ten percent reported in this investigation. Repeated instruction, application, and practise of the strategy may perhaps serve to develop imaging abilities that would promote the growth and refinement of comprehension skills for most readers. To discount the importance of mental visual imagery on the basis of what to some researchers, appears to be a small gain (e.g. Pressley, 1977; Levin, 1979) could be to ignore a potentially advantageous reading comprehension strategy. The development and refinement of instructional methods and a long term application of the treatment may serve to evoke and maintain an effective, efficient, readily available, imaging strategy to aid in prose learning.

The unadjusted cell means (see Figure 1) show an increase in mean scores for the control group as well as for the experimental subjects.

Unlike that of the imagery treatment group, the gain was not statistically significant; however, it should be noted for while it may be due to the test-retest effect or the halo effect it may, on the other hand, indicate that the instructional sessions provided for the control group were instrumental in improving the comprehension of prose for these subjects. Asking children to concentrate on what they read and having them practise this strategy may, to some extent, increase the reader's ability to comprehend prose.

Units of Relevant Information Generated

Although the Standard Reading Inventory (McCracken) is an adequate instrument for the measurement of reading comprehension, its nature delimits an accounting for the full extent of information generated in the processing and comprehension of text by a reader. By restricting the measurement of comprehension of a passage to ten specific questions much information generated by the reader may not be acknowledged in the test result. For this reason, unaided recalls were analyzed to compare the full extent of information generated in the recalls before and after treatment (see Appendix H).

Hypothesis 2

There will be no significant difference in the total amount of relevant information generated in the unaided immediate recalls after mental visual imagery instruction.

This hypothesis was rejected.

An analysis of variance (Table 5.1) indicated a significant difference in the amount of information generated by experimental and control subjects in the unaided immediate recalls of story information. Therefore, group means were further analyzed to determine the source of significance (see Table 5.2).

TABLE 5.1

Significance Test of Analysis of Variance for the Units of Information Generated by Fourth Grade Experimental and Control Subjects in the Unaided Immediate Recalls of Story Information

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio
Groups	345.129	2	172.565	4.676[1]

[1]Significant at .05 level ($p < .05$).

An analysis of post-test cell means using the Tukey method of comparison indicated a significant difference between the experimental and control groups in the amount of information generated in the unaided immediate recalls (see Table 5.2; $p < .05$).

TABLE 5.2

Cell Means for Units of Information Generated by the Experimental and Control Subjects in their Unaided Immediate Recalls of Story Information

Group	Pre-Test Mean	Standard Deviation	Post-Test Mean	Standard Deviation	F Ratio
Experimental	14.900	7.844	20.750	10.077	3.628[1]
Control	14.500	7.590	14.800	8.042	

[1]Significant at .05 level ($p < .05$).

Visual imagery instruction increased the units of relevant information generated by the experimental subjects from a pre-test mean of 14.90 to a post-test mean of 20.75, a gain of approximately six (5.9) units of

relevant information in the latter test significant at the .05 level ($p < .05$). The control group averaged an increase of less than one half (.30) a unit of information per recall in the post-test (see Figure 2). The difference in the standard deviations of post-test means (10.007 for the experimental group and 8.042 for the control group) suggests the highly positive influence of the imagery instruction upon those members of the experimental group who were readily able to utilize visual imagery as an aid to comprehension after a brief exposure to instruction in the use of strategy.

Discussion

Unlike the results of this study, the findings of the Kulhavy and Swenson (1975) investigation did not show a significant increase of information in the immediate recall, nonetheless, recall generation of information was sufficient enough for them to conclude: "The important finding of this study is that grade school students remember more from a text if they try to form mental images while reading." (p. 51). The findings of the present study provide support (statistically significant) for the conclusion of Kulhavy and Swenson regarding the facilitative effects of mental visual imagery instruction.

Paired associate experiments have led researchers (e.g. Paivio, 1971; Bower, 1972) to attribute associative properties to imagery in that it links or relates items of information and transforms them into unified structures. Steingart and Glock (1979) suggest these transformations result from a higher level of mental processing. That is, readers who image evidence an increase in inferential processing of text information (p. 80). In prose comprehension mental visual imagery may function in a manner similar to that hypothesized by the paired associate

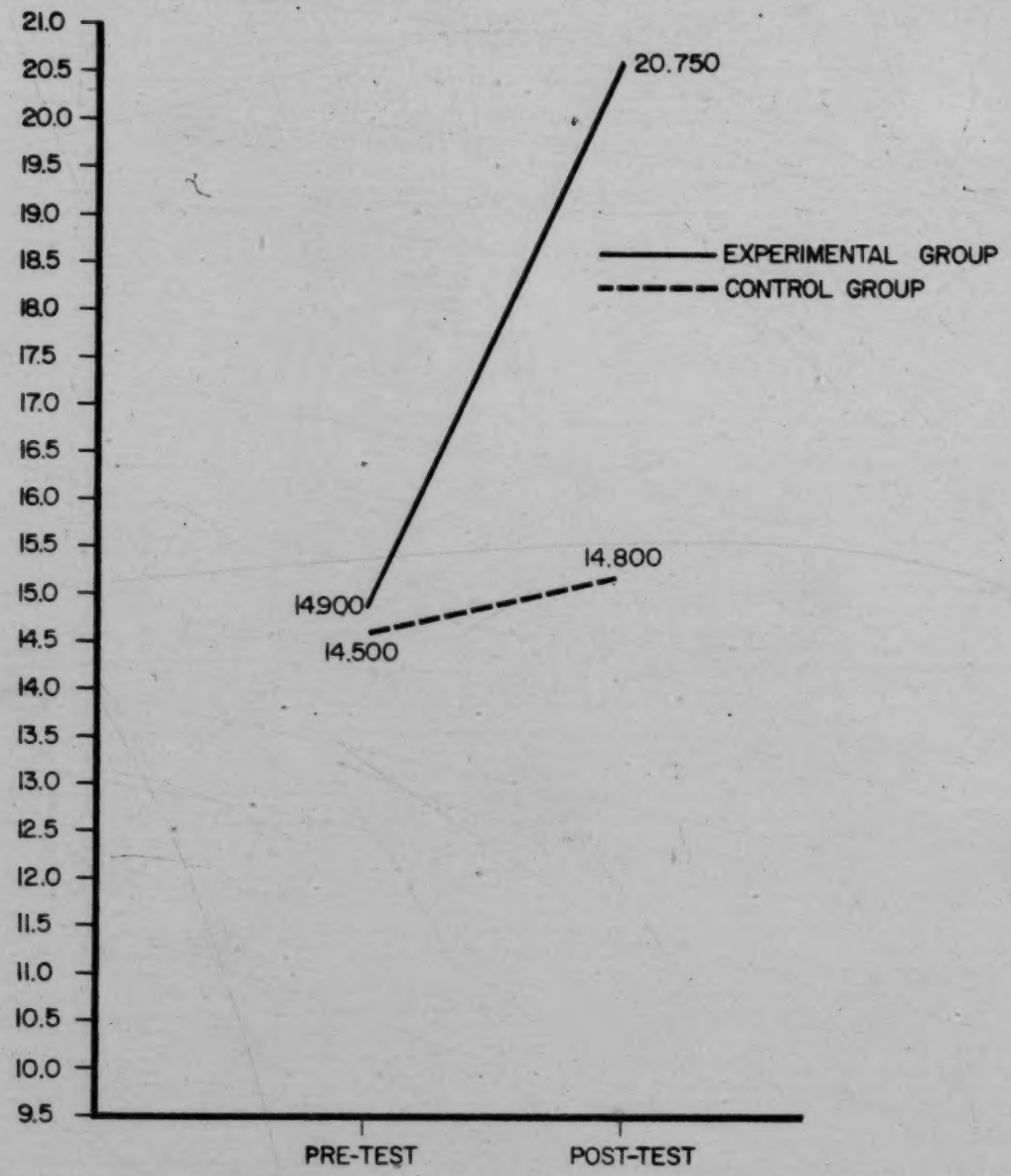

FIGURE 2

Cell Means for Units of Information Generated by the Experimental and Control Subjects in Their Recall of Story Information

researchers. It may foster the relating of the many units of passage information into a unitized, interactive, meaningful, episode. The unit may then assist the reader to keep the passage content intact and when recall is triggered, the units of information that comprise the relationships are generated and remembered in a unified structure. Therefore, a more complete recall of the passage information is made available to the image generating reader.

Performance on Delayed Recalls of Information

Learning includes the acquisition, storage, and retrieval of information and much of the importance in learning lies in how accurately the learned and stored information is remembered over time. As noted in Chapter II, mental visual imagery has been touted as a mnemonic device for at least two centuries. Despite the longevity of the claims regarding its value in the retrieval of information, debate continues as to the effectiveness of visual imagery in the accurate recall of information. Sheehan (1972, p. 149) summarized the current status of imagery thus:

> It is hard indeed not to be forcibly impressed by the 'adaptive luxury' of Galton's (1911) view of imagery where imagery is an inventive, highly useful mechanism allowing actions to be easily and effortlessly recalled. Yet, Jenkin (1935) found no such evidence for the impressive nature of imagery; to her visual imagery was vastly inferior to other aids to memory. We are to be caught it seems somewhere between the conception of images 'as an army of helpers rushing to the mind's assistance' (Betts, 1909, p. 53) and more sobering notions of imagery as the view that it goes farther to individualize situations than is at all biologically useful. (Bartlett, 1927).

In view of the uncertainty surrounding the utility of mental visual imagery, an attempt was made in this study to determine whether it is a beneficial strategy to teach fourth grade students for use in the storage and retrieval of prose information.

To test the effectiveness of visual imagery instruction on the retention and retrieval of prose information a delayed recall was taken. One week from the day of post-testing the Standard Reading Inventory (McCracken) was readministered, soliciting an unaided and aided recall from the subjects.

Hypothesis 3

There will be no significant difference between groups in the amount of relevant information retained over time.

(a) in the aided and unaided recalls of information required in the achievement test

(b) in the total number of units of information recalled.

This hypothesis was rejected.

Hypothesis 3a was rejected at the .05 level of significance (Table 6.1). To obtain group means an analysis of variance with repeated measures was applied to the data. A comparison of the means using the Tukey method of comparison indicated that the experimental group recalled significantly more information required in the Standard Reading Inventory (McCracken) than did the control group. (See illustration: Figure 3).

TABLE 6.1

Cell Means for the Information Recalled in the Aided and Unaided Delayed Recalls by Fourth Grade Experimental and Control Subjects as Measured by the Standard Reading Inventory (McCracken)

Group	Mean Score	Standard Deviation	F Ratio
Experimental	11.857	3.329	3.05[1]
Control	9.619	2.423	

[1]Significant at the .05 level ($p < .05$).

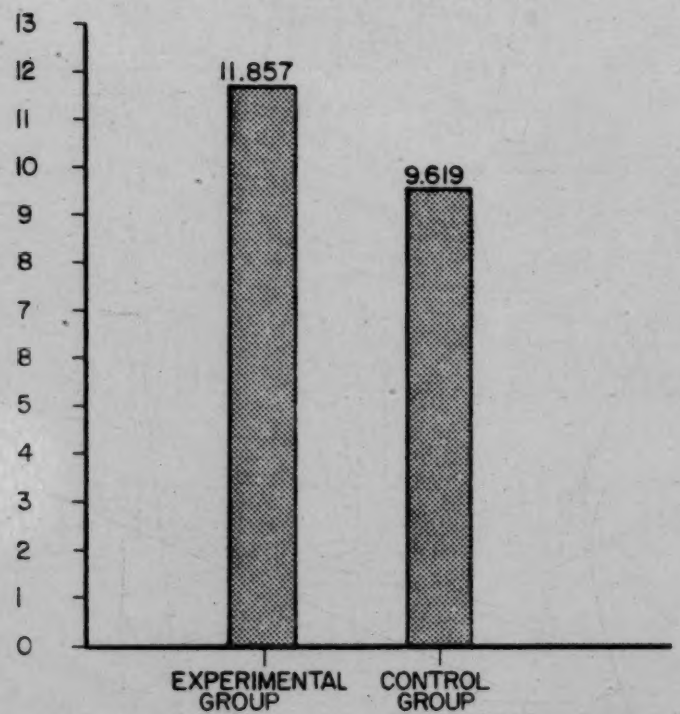

FIGURE 3

Cell Means for the Information Recalled in the Aided and Unaided Delayed Recall by Fourth Grade Experimental and Control Subjects as Measured by the Standard Reading Inventory (McCracken)

Hypothesis 3b was rejected at the .01 level of significance (see Table 6.2). The unaided recalls were divided into units of information (i.e. t-units, incomplete t-units, and partial t-units) and means were obtained through an analysis of variance. The difference between experimental and control group means was analyzed using the Tukey method of comparison. The experimental group stored and recalled significantly more units of information as compared to the control group. (See illustration: Figure 4).

TABLE 6.2

Cell Means for the Total Units of Information Recalled in the Delayed Unaided Recalls by the Experimental and Control Subjects

Group	Mean Score	Standard Deviation	F Ratio
Experimental	16.400	10.499	5.305[1]
Control	7.700	5.090	

[1]Significant at the .01 level ($p < .01$).

Discussion

Contrary to the suggestion of Palermo (1970) that the effects of a visual imagery strategy may be limited to immediate recall, the imagery instruction in this study appeared to have facilitated the retention and retrieval of information over time. Table 6.1 illustrates the influence of imagery instruction on the delayed recall test. In the combined unaided and aided recall test, the imagery treatment group recalled approximately ten percent more of the twenty possible recall units of information than did the control group (experimental group mean - 11.857 = 59%;

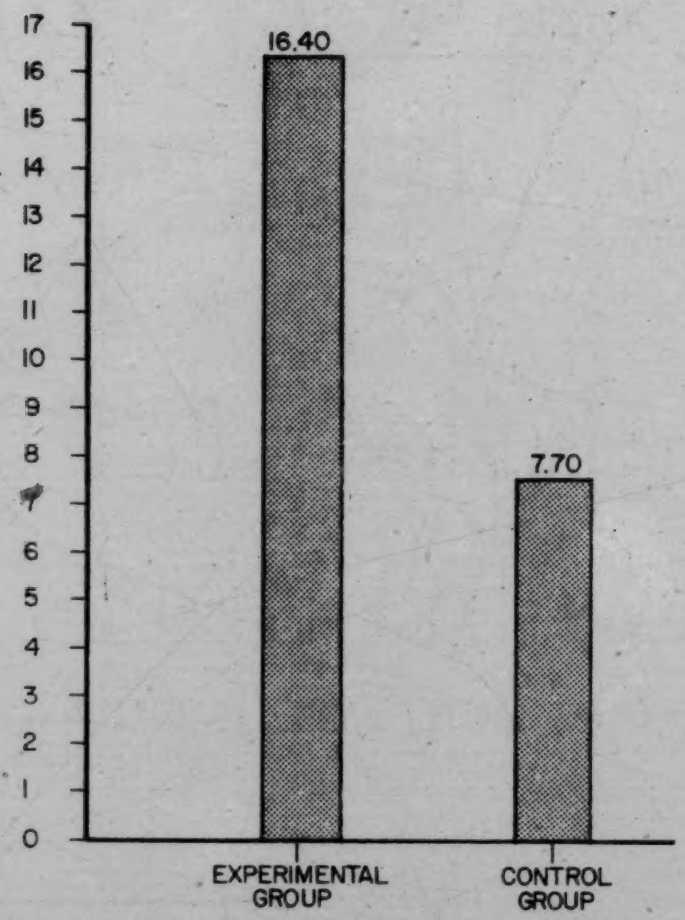

FIGURE 4

Cell Means for the Total Units of Information Recalled in the Delayed Unaided Recall by the Experimental and Control Subjects

control group mean - 9.619 = 48%). In the spontaneous unaided response, the experimental group stored and recalled an average of twice as many units of relevant information than the control group. However, Table 6.2 illustrates a standard deviation of 10.499 for the experimental group whereas the standard deviation of the control group is only 5.090. A possible explanation for the greater standard deviation in the imagery treatment group is that through use of visual imagery, some subjects increased their scores disproportionately. Perhaps inherently or through past instruction, some subjects had previously developed their visual imaging abilities and were able to further refine the strategy as a result of the instruction offered in this investigation. Or possibly, in some subjects, an imagery potential may have been dormant, waiting for development and through exposure to instruction in this study the potential was nurtured into a strong, proficient aid to prose comprehension.

The results of the Kulhavy and Swenson (1975) study are supported by the findings of this investigation. Kulhavy and Swenson provided fifth and sixth grade students with minimal imagery instruction (e.g. told students to form pictures in their heads while reading twenty paragraphs of text). One week after a post-test had been administered, subjects participated in a delayed written test. The delayed scores were reported as being superior for the imaging students and the researchers describe imagery instruction as having increased the amount of text content remembered over time (p. 47).

From the results of paired associate laboratory experiments, Paivio (1971) hypothesized that imaging provides the reader with a meaningful representation of information. The findings of this study indicate that, as in paired associate learning, text learning is also enhanced by visual

imagery. Use of an imaging strategy may provide a meaningful synthesis of information fostering the storage and recall of story propositions. The memory trace and associative functions of imagery seem to strengthen the retrieval of this information. Therefore, exposing readers to imagery instruction may well provide them with a mnemonic skill that promotes the retention and retrieval of prose information.

The Nature of the Comprehension Processes

The need for further investigation into the processes upon which comprehension is incumbent was expressed by Lesgold et al. (1975). They asked for clarification of the nature of comprehension skills which could be improved through direct instruction. A purpose of this study was to investigate the effects of visual imagery training on the comprehension processes used by subjects as they read and interpreted the passages of the Standard Reading Inventory (McCracken). Unaided recalls were analyzed in accordance with the four steps outlined in the Comprehension Categories for Protocol Analysis (Fagan, in press), (see p. 26). Five processing strategies are defined in the analysis:(A) text exact;(B) text specific; (C) text entailed;(D) text experiential; and(E) text erroneous. Categories C and D represent the higher levels of comprehending. A combination of processing strategies B, C, and D (with a de-emphasis on B) is likely to produce proficient comprehension of prose text).

Hypothesis 4

There will be no significant difference in the frequency of units which fall into each of the following comprehension categories after mental visual imagery instruction.

(a) text exact

(b) text specific

(c) text entailed

(d) text experiential

(e) text erroneous

This Hypothesis was not rejected.

The analysis of variance summary table 7.1 in Appendix J shows no significant differences between processing strategies used before and after treatment by the fourth grade experimental and control subjects.

Category A - Text Exact Processing

Higher level mental processing is not a requirement for the production of a unit of information in this category. Information is recalled verbatim from the text but the exact recall does not necessarily imply comprehension.

TABLE 7.2

Cell Means of the Experimental and Control Subjects' Text Exact Processing of Information as Measured by the Comprehension Categories for Protocol Analysis

Group	Pre-Test Mean	Standard Deviation	Post-Test Mean	Standard Deviation
Experimental	1.231	0.951	1.462	1.472
Control	1.316	1.305	1.613	1.387

Discussion

The amount of rote memory processing by the experimental subjects did not differ significantly after treatment. Both groups showed a negligible increase in text exact processing on the post-test. However, as Table 7.2

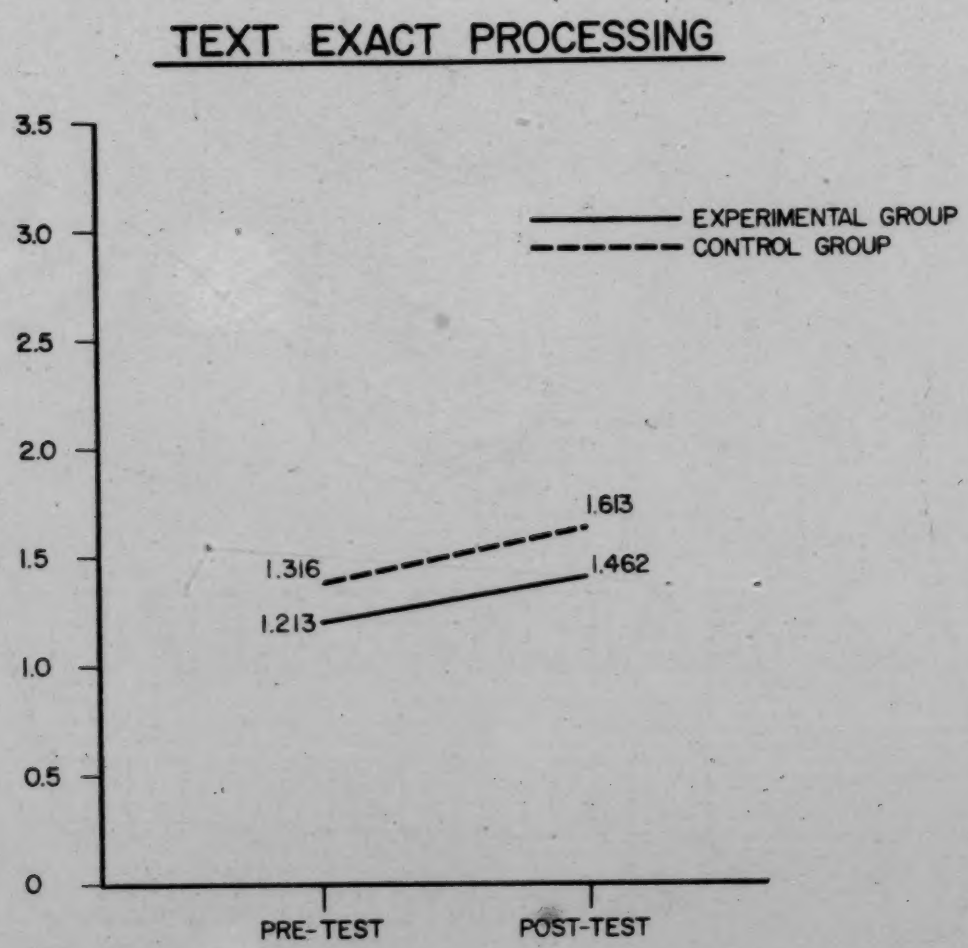

FIGURE 5

Cell Means of the Experimental and Control Subjects' Exact Processing of Information as Measured by the Comprehension Categories for Protocol Analysis

and Figure 5 illustrate, the experimental group seems to have relied slightly less upon the rote storage and rote recall of information than did the control group.

Category B - Text Specific Processing

In processing the information the reader may reorder or reword units having specific reference in the text. The reordering or rewording of information implies a somewhat higher level of processing than may have occurred in Category A processing.

TABLE 7.3

Cell Means of the Experimental and Control Subjects' Text Specific Processing of Information as Measured by the Comprehension Categories for Protocol Analysis

Group	Pre-Test Mean	Standard Deviation	Post-Test Mean	Standard Deviation
Experimental	6.193	3.770	6.077	3.469
Control	6.024	3.896	4.720	2.910

Discussion

The two factor analysis of variance revealed no significant difference in the transformation of information including the substitution of pronouns or synonomous replacement of words. There appeared to be a decrease in text specific processing between pre-and post-testing for both groups (Table 7.3). However, Figure 6 illustrates the greater decrease in frequency of text specific processing as experienced by the control group. The experimental group seemed to be somewhat more adept at transforming the post-test passage information into more personal but synonomous interpretations of the text.

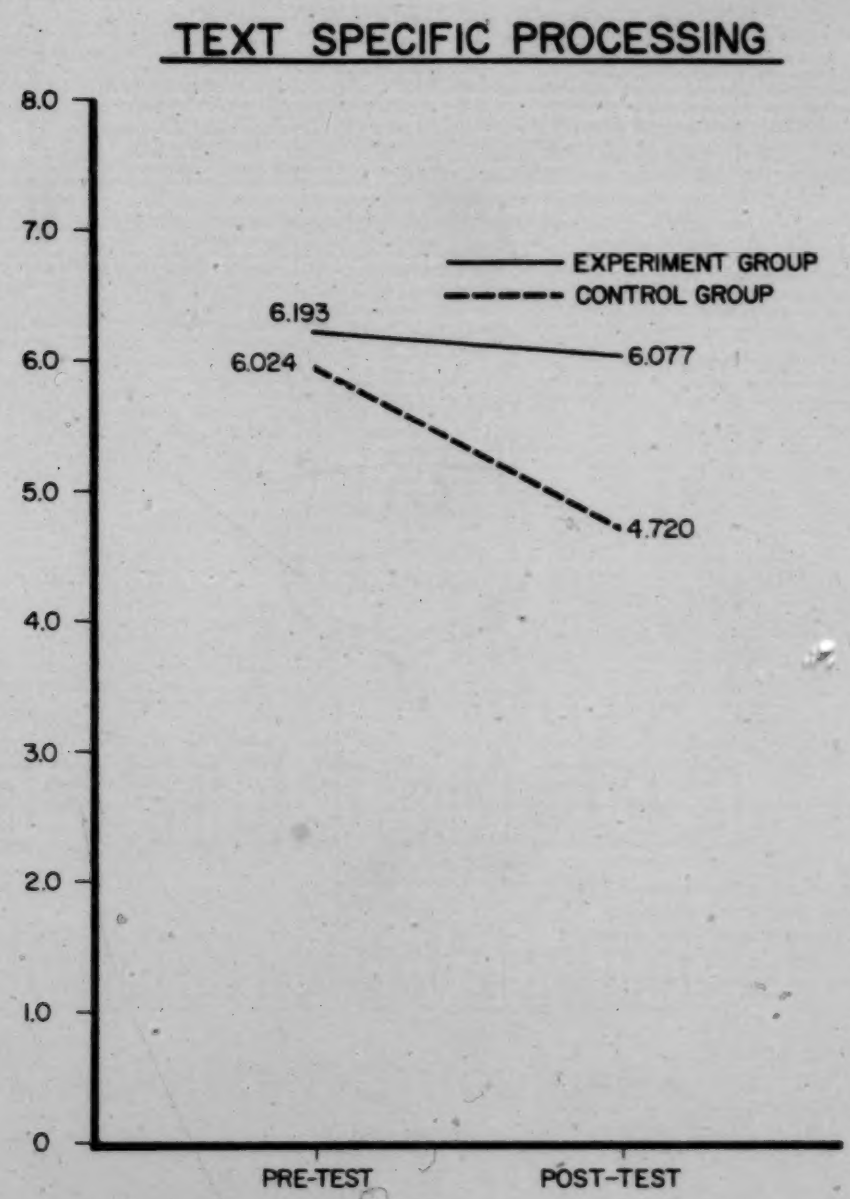

FIGURE 6

Cell Means of the Experimental and Control Subjects' Text Specific Processing of Information as Measured by the Comprehension Categories for Protocol Analysis

Category C - Text Entailed Processing

Higher level mental processing is involved in this category. The reader synthesizes and/or summarizes units of information from across the passage to construct valid interpretations of the text.

TABLE 7.4

Cell Means of the Experimental and Control Subjects' Text Entailed Processing of Information as Measured by the Comprehension Categories for Protocol Analysis

Group	Pre-Test Mean	Standard Deviation	Post-Test Mean	Standard Deviation
Experimental	1.654	1.497	2.808	2.110
Control	1.649	1.781	1.769	1.566

Discussion

Despite a nonsignificant finding between pre-and post-test processing (Table 7.4) a comparison of the group means as shown in Figure 7 indicates a substantial difference in the text entailed processing used by the two groups after treatment. The experimental group appears to have utilized text entailed processing more extensively than the control subjects. This finding would support the assumption that an imaging strategy serves to strengthen the reader's ability to establish relationships between units of information in a prose passage and to "fuse separate meanings into a stream of ideas." (Gray, 1960; p. 13). Thus visual imagery aids in the summarization and organization of information into a comprehensible and memorable sythesis for maintenance and retrieval.

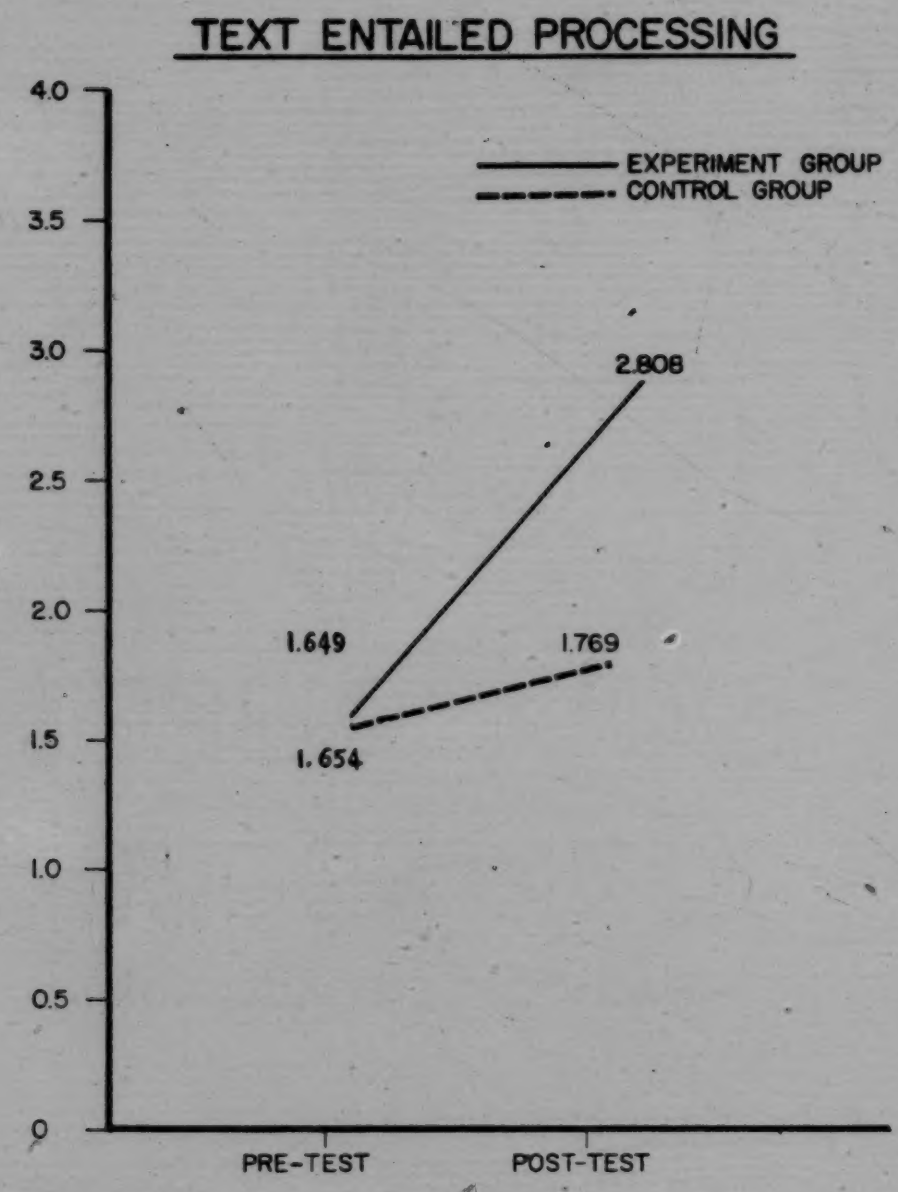

FIGURE 7

Cell Means of the Experimental and Control Subjects' Text Entailed Processing of Information as Measured by the Comprehension Categories for Protocol Analysis

Category D - Text Experiential Processing

The reader effectively draws upon background knowledge to construct information suggested but not stated by the text.

TABLE 7.5

Cell Means of the Experimental and Control Subjects' Text Experiential Processing of Information as Measured by Comprehension Categories for Protocol Analysis

Group	Pre-Test Mean	Standard Deviation	Post-Test Mean	Standard Deviation
Experimental	1.769	1.732	0.923	0.990
Control	1.459	1.789	0.738	0.832

Discussion

No significant difference was found in the pre-and post-test experiential processing of text information (Table 7.5 and Figure 8). In this analysis, the introduction of an imaging strategy did not seem to facilitate the reconstruction of story information through use of background knowledge. Nor did a visual imaging strategy appear to enhance inferential processing as measured by the Comprehension Categories for Protocol Analysis. This finding is contrary to that of Steingart and Glock (1979) who reported a significant increase in inferencing among their imagery subjects.

With reference to the present study, it should be noted that the ability to make inferences is initially dependent upon the reader having background experiences from which to draw information to facilitate the inferencing process. The reader must be able to combine two essential ingredients - background knowledge and text information -

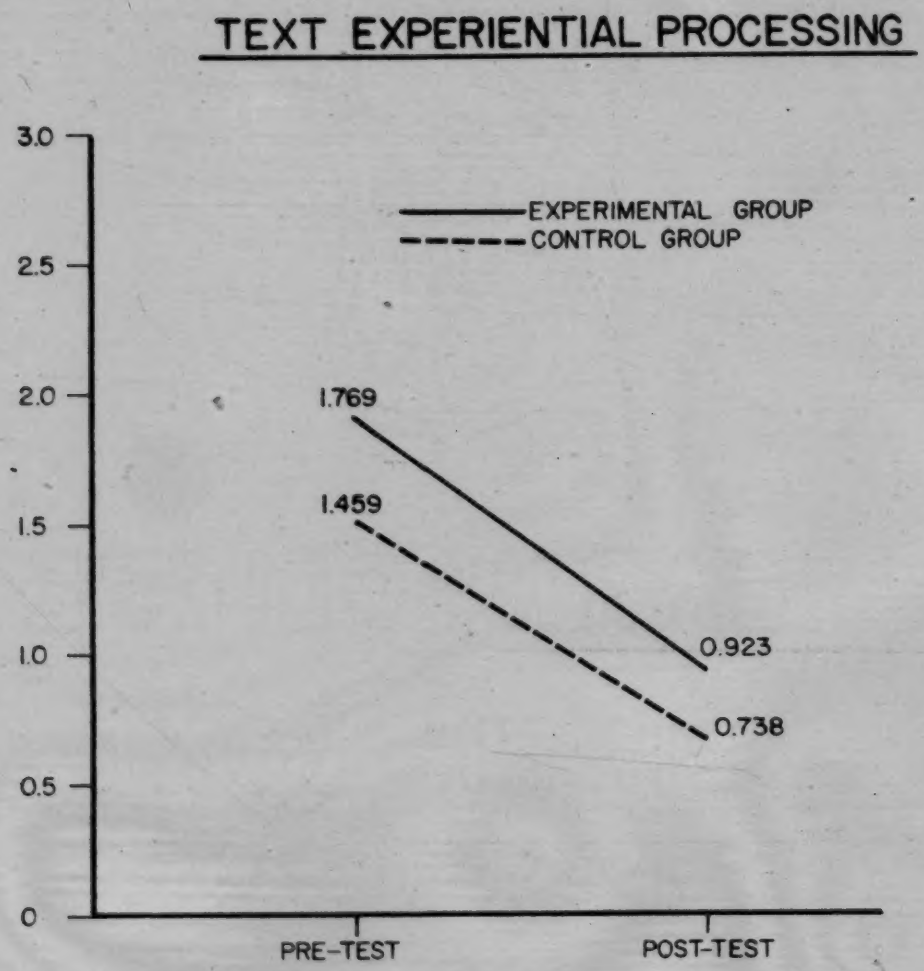

FIGURE 8

Cell Means of the Experimental and Control Subjects' Text Experiential Processing of Information as Measured by Comprehension Categories for Protocol Analysis

before inferences can be made. The experimental and control subjects in this investigation may have been deficit in background knowledge of the American pioneer Daniel Boone (the topic of the final test passage) and the life-style of early Americans. The drop in post-test means (see Figure 8) may be indicative of such an occurrence. The experimental and control subjects may have been unable to engage in inferential thought simply because they had little previous knowledge of American frontiersmen and their way of life.

The diminished use of Category D processing by subjects in the post-test of this study may indicate a lack of background knowledge. In which case, visual imagery instruction could not assist the reader to reconstruct or fill in information suggested by the text because an element necessary to Category D processing - background knowledge - was missing.

Category E - Text Erroneous Processing

The reader incorrectly processes information in the initial attempt at comprehension or when producing a recall of passage information.

TABLE 7.6

Cell Means of the Experimental and Control Subjects' Text Erroneous Processing of Information as Measured by the Comprehension Categories for Protocol Analysis

Group	Pre-Test Mean	Standard Deviation	Post-Test Mean	Standard Deviation
Experimental	2.654	2.197	1.346	1.118
Control	2.238	2.329	1.524	1.411

Discussion

The statistical analysis revealed no significant difference in the erroneous responses between pre-and post-test means (see Table 7.6). Nonetheless, a comparison of experimental and control group means shows an average decrease of 1.3 erroneous responses per subject in the experimental group whereas the average decrease for control subjects was only 0.7 fewer erroneous responses (see Figure 9). Perhaps the benefits accrued in synthesizing and summarizing (text entailed processing) facilitated a correct interpretation initially and then promoted an accurate recall of that information thereby reducing the number of erroneous units in the recall of the passages.

Summary

Although none of the five comprehension processing means changed significantly with imagery instruction, there were indications of a positive imagery treatment effect. The experimental group seemed to rely slightly less on rote memory and to transform information into personally meaningful units more frequently than the control subjects. Synthesis and summarization appeared more often in the recalls of the experimental group indicating the occurrence of higher level processing. Finally, a noticeable, if nonsignificant reduction in erroneous responses was observed in the recalls of the experimental group. These minor changes in the comprehending processes seem to have combined to produce the significant difference in the comprehension of prose as reported in Hypothesis 1.

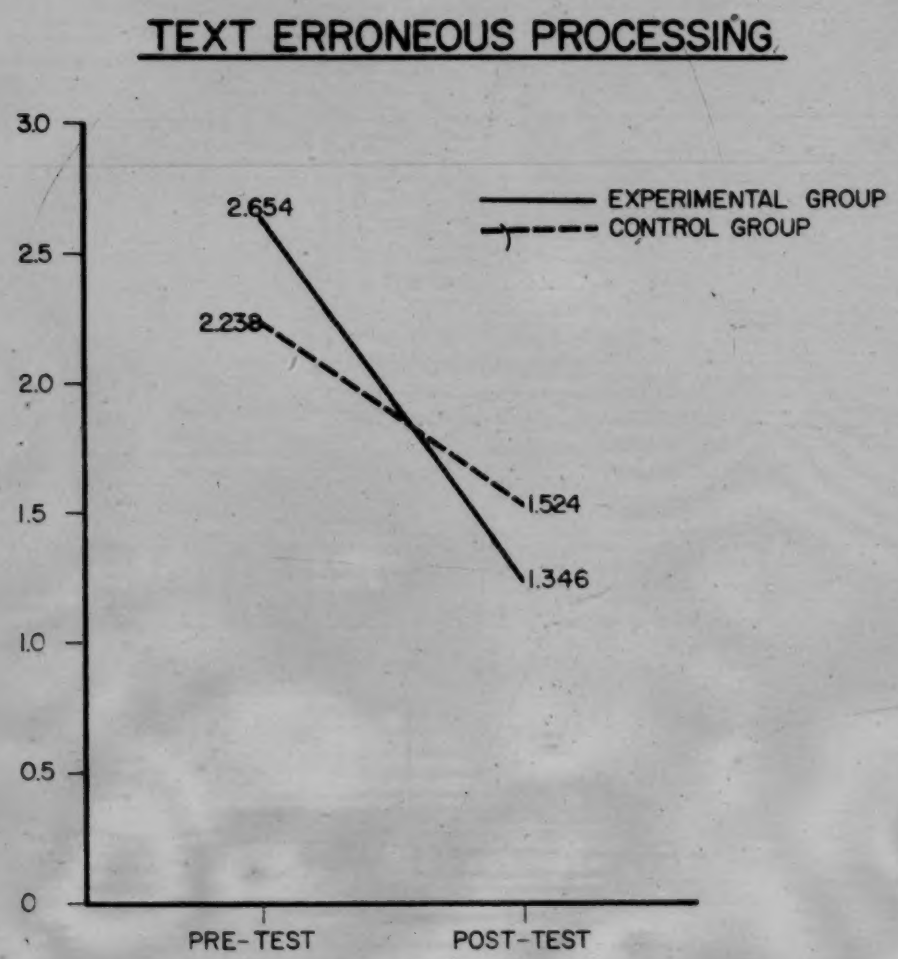

FIGURE 9

Cell Means of the Experimental and Control Subjects' Text Erroneous Processing of Information as Measured by the Comprehension Categories for Protocol Analysis

Skill Group Achievement

A purpose of this study was to further investigate Levin's hypothesis regarding the positive influence of mental visual imagery instruction on the reading comprehension of readers he had categorized into decoding and comprehension skill groups. The skill groups were formed on the basis of adequate or low performance in decoding and comprehension. In the Levin study, adequate decoders/low comprehenders seemed to derive the most benefit from imagery instruction. To establish skill groups for the present investigation, an adequate decoding or comprehension score was set at fifty or above as determined by the results on the Edmonton Public Schools Elementary Reading Test: Grade Three and a low score was set at forty-five or below. Four combinations of adequate and low decoding and comprehension groups were thus designed and their performance was analyzed for achievement.

Hypothesis 5

There will be no significant difference in the achievement of the following skill groups after mental visual imagery instruction.

(a) adequate decoders/adequate comprehenders

(b) adequate decoders/low comprehenders

(c) low decoders/adequate comprehenders

(d) low decoders/low comprehenders

Discussion

A two-way analysis of variance for unequal numbers detected no significant differences in the achievement of the skill groups. However, it is important to note that groups were comprised of unequal numbers (Table 8.1). For example, the adequate coders/low comprehender experimental group had two members while the companion control group

TABLE 8.1

CELL MEANS FOR THE COMPREHENSION ACHIEVEMENT OF FOURTH GRADE EXPERIMENTAL AND CONTROL DECODING/COMPREHENSION SKILL GROUPS AS MEASURED BY THE STANDARD READING INVENTORY (McCracken)

Group	Pre-Test Mean	Standard Deviation	Post-Test Mean	Standard Deviation	Number of Cases
Experimental ad[1]/ac[2]	12.000	4.359	16.000	4.313	11
Control ad/ac	12.571	4.685	15.286	3.251	07
Experimental ad/lc[3]	11.000	2.828	12.500	0.707	02
Control ad/lc	9.286	3.094	10.143	3.671	07
Experimental ld[4]/ac	3.000	0.000	12.000	0.000	01
Control ld/ac	13.000	1.414	14.500	0.707	02
Experimental ld/lc	8.750	2.375	12.375	3.926	08
Control ld/lc	10.778	3.866	13.000	3.873	09

[1]Adequate Decoding
[2]Adequate Comprehension
[3]Low Comprehension
[4]Low Decoding

consisted of seven members. Attention should also be directed toward the small numbers in some groups (e.g. low decoder/adequate comprehender experimental group n = 1). Had a more equal distribution of subjects in each group occurred, the results may possibly have differed from the findings reported in this investigation. A comparison of means shows no indication of support for Levin's postulation concerning the benefits of imagery for adequate decoders/low comprehenders. Because there was only one member in the low decoder/adequate comprehender experimental group it is unlikely that this result is representative of the general population of low decoders/adequate comprehenders. Although subjects were allowed to ask for help in decoding as they read, no subjects requested the support in the testing passages. Otherwise, prompting may have invalidated their decoding rating. The means of all experimental adequate/low skill groups suggest at least a slight gain in achievement after treatment as compared to those of the control group.

Summary of Results

Five null hypotheses were tested in this study. Subjects were pretested to obtain a basal score of reading comprehension and were then exposed to two instructional sessions and finally, a post-test. The lessons of the experimental group contained a mental visual imagery component that was not included in the instruction of the control group. Pre- and post-test results were compared to determine the degree of achievement. Of the five hypotheses formulated, three were rejected. Mental visual imagery instruction was found to significantly improve the reading comprehension of fourth grade readers. Exposure to comprehension instruction may have also increased the achievement level of

the control group. A significant increase in the amount of relevant information generated by experimental subjects followed the visual imagery instruction. The significant effects of mental visual imagery instruction were also noted in the amount of information retained over time by the experimental group.

Two hypotheses were not rejected. No significant difference in the mental processing of text information by experimental group readers was determined through statistical analysis. Nonetheless, the mean scores indicated an increase in some areas of higher level mental processing after the experimental instructional treatment. The achievement of the decoding/comprehension skill groups was not altered significantly by mental visual imagery instruction in this study but a slight increase of the experimental decoding/comprehension skill group means was noted.

CHAPTER V

CONCLUSIONS AND IMPLICATIONS

This chapter presents a general overview of the study, the main findings and conclusions. Implications for the teaching of reading and suggestions for further research are also presented.

The Study in Review

The major purpose of the study was to examine the effects of mental visual imagery instruction on the reading comprehension of fourth grade students. To do this with as much validity as possible within the framework of the variables concerned, Design 4 as outlined by Campbell and Stanley (1963) was implemented and then supplemented with a delayed observation. The experimental group format consisted of a pre-test observation, an application of visual imagery instructional treatment followed by a post-test observation, and finally, a delayed observation made one week subsequent to post-testing. The control group format was identical to that of the experimental group with the exclusion of the visual imagery component in the instructional treatment.

The visual imagery treatment for the experimental group was inserted into a basic instructional program designed for both groups with the intent to increase internal validity. Two well rehearsed lessons were taught by a qualified teacher to groups of approximately seven children. Subjects were made aware of the purpose of the instruction and were reminded to make use of the strategy introduced during the lessons in future reading. Lessons included listening, speaking, silent reading, and drawing activities with instruction followed by the application and practise of the strategy introduced. The final lesson included materials

similar in style and format to those used in the post-test to promote the transfer of learning (i.e. the imaging strategy) from the instructional to the testing situation.

To control for the teacher variable and to ensure unbiased testing and scoring by the investigator, all instructional sessions were conducted by the same independent teacher. Thus, during the collection and scoring of data, the investigator remained unaware as to which group (experimental or control) a subject belonged.

The data were collected from a sample of fifty-two subjects randomly selected from an assigned population of one hundred thirty-seven fourth grade pupils from two schools in the Edmonton Public School District. Subjects were randomly assigned to one of two groups - experimental or control. An attempt at matching for sex was not totally successful for, from the original twenty-eight boys and twenty-eight girls selected, three boys and one girl were eliminated from the study because of inattendance at an instructional or testing session.

Results of the Canadian Cognitive Abilities Test and the Edmonton Public Schools Elementary Reading Test: Grade Three were recorded and analyzed to ensure that experimental and control group subjects were derived from the same parent population. T-tests for independent means were used to analyze the recorded data. Achievement level was obtained from performance on the Standard Reading Inventory (McCracken). Subjects were pre-and post-tested individually by the investigator. After reading a passage silently, the subject was asked to recall the content of the passage. Recalls (unaided and aided) were expected to provide the answers for ten questions that comprised the test for each passage read. Two fourth reader level passages were read by the subjects at each testing session.

The delayed observation consisted of having the subject recall the post-test stories. The recalls were scored and means were computed with a one factor analysis of variance and covariance, the pre-test being the covariant. Recalls were tape recorded and transcribed for further analysis.

The Comprehension Categories for Protocol Analysis was the instrument of analysis in determining the comprehension processes used by the subjects as they interpreted the passages read. To establish the comprehension categories, the protocols were first analyzed for mazes which were then discarded. T-units and incomplete t-units were determined and assigned to categories according to their content. The number of units in each category was recorded for computer analysis. Subsequent to this procedure, t-units and incomplete t-units were further divided into partial t-units in order to ascertain the total amount of information offered in the recalls. These units were counted and recorded for computer analysis using a two-way analysis of variance with repeated measures.

The intent of the delayed recall test was to measure the amount of information the subjects retained and recalled over time. The data gathered in this observation were analyzed by an analysis of mean variances.

From the results of the Edmonton Public Schools Elementary Reading Test: Grade Three, subjects were categorized according to decoding and comprehension skills. An adequate/low split was devised in which subjects who scored fifty or above in a skill were classified as being adequate in that skill. A subject whose score was forty-five or below in a skill was deemed to be low in that skill. The four groups formed

were: adequate decoders/adequate comprehenders; adequate decoders/low comprehenders; low decoders/adequate comprehenders; and low decoders/low comprehenders. The means of the four groups were compared through an analysis of variance for unequal numbers. Satisfactory interrater reliability was established when the coding of the data by the investigator compared favorably with that of an independent judge.

Major Findings and Conclusions

The main finding of this study was the indication that mental visual imagery instruction improved fourth grade readers' comprehension of prose. In this study, the degree of comprehension improvement is similar to that found in previous studies where mental visual imagery increased the comprehension of prose. It has been argued in this report that when suggesting the limited value of mental visual imagery in prose comprehension, Levin (1979) may be somewhat pessimistic and premature. A ten percent gain can raise a reader from a frustration level of comprehension to an instructional comprehension level as measured by the Standard Reading Inventory (McCracken) or alternatively from an instructional level to an independent comprehension reading level. A gain of ten percent in comprehension cannot be discounted as inconsequential, albeit not great in magnitude.

Several of the studies discussed in this report were not designed to replicate a classroom reading comprehension program. In many instances, instructional procedures and/or materials used were not intended to be representative of those encountered by students in a typical reading program. An intent of the present investigation was to replicate as closely as possible, within the constraints of time, a classroom instructional program comprised of activities and material

that might be used in a typical grade four classroom. More comprehensive instructional lessons were conducted in this study than in several of the previous investigations. The testing material differed from that used in many other studies in that it was not purposely selected for its tightly structured, highly concrete (imaginable) content but rather was more representative of the less highly organized somewhat abstract content encountered in fourth grade prose texts.

Although there was a statistically significant gain in achievement by the experimental subjects, it was not much greater than that of several other investigations despite an attempt in this study to make improvements in the instructional presentation. In speculating as to why greater gains did not result from the attempt to improve instruction, a second change in the design should also be considered. The prose content of the testing passages was less concrete than content of the materials used in many previous studies. Paivio (1970) suggested that visual imagery might be less effective with abstract content than with concrete content. Therefore, the expected increase in achievement level brought about by an improvement in training may have been counterbalanced by the less concrete content of the testing passages, thus accounting for the similarity in gain scores between this and several other studies. Had highly imaginable content (concrete) been used in the present investigation, it might have resulted in a higher achievement level for the experimental group than is here reported.

Concurrent with the improvement in comprehension as measured by the Standard Reading Inventory (McCracken) a significant increase in the amount of relevant information generated in the recalls of the experimental group was also noted. Comparatively, the experimental group

offered approximately twenty-one units of information per recall while fifteen units of information comprised the average recall of the group. A reasonable explanation for this result seems to be that visual imagery unitizes and integrates the many units of information in a story keeping the passage content relatively intact and available for recall. This explanation may also account for the results of the delayed recall taken one week after post-testing. Analysis of the unaided recalls indicated that a mental visual imagery strategy, as well as increasing the amount of information learned, also retarded the forgetting of that information. The experimental group recalled significantly more information over time than the control did in this study.

No significant differences in mental processing as measured by the Comprehension Categories for Protocol Analysis were noted. An attempt to identify the processes influenced by an imaging strategy, yielded data to suggest an increase in the synthesizing and summarizing of information by the experimental subjects. Units of information were taken from across the passages and related in more succinct, informative, recalls by the experimental subjects than by the control subjects. It was concluded that the fourth grade subjects in the experimental group may have achieved at a higher level of comprehension than the control group in this study because they generated more valid information in their recalls due to improved synthesis and summarization processing. An increase in inferential processing as reported in the Steingart and Glock (1979) study was not noted in this study, perhaps in part because of the subjects' deficiency in experiential knowledge of the content of at least one of the test stories (i.e. Daniel Boone).

No significant difference was noted in the achievement of any of the decoding/comprehension skill groups. Unlike the Levin (1973) study which implicated visual imagery as a facilitator of prose comprehension for adequate decoders/low comprehenders, this study showed no significant gain in any of the four designated skill groups. However, the small and unequal numbers in the groups seriously weakened the validity of these results.

General Conclusions

On the basis of the findings related and restricted to this study, the following general conclusions were drawn:

1. Mental visual imagery instruction significantly improved the comprehension of prose. The finding indicates that comprehension is amenable to direct teaching.
2. Mental visual imagery instruction significantly increased the amount of relevant information generated by readers for immediate recall.
3. Mental visual imagery instruction significantly increased the amount of relevant information retained over time.
4. Mental visual imagery instruction did not significantly alter the mental processes used in comprehending prose. However, visual imagery instruction influenced the mental processing of story information in so far as an increased amount of synthesizing and summarizing was noted in the passage recalls.

5. Mental visual imagery instruction did not significantly increase the comprehension of prose more so for any one of the decoding and comprehension skill groups as compared to the other decoding and comprehension skill groups.

Limitations

In addition to those limitations cited in Chapter I, the following limitations should be noted.

Subjects received instruction in small groups consisting of approximately seven students. This may not represent a realistic instructional setting from which to generalize the results reported in this study to a classroom reading comprehension program.

The comprehension strategy was presented to the children by a teacher with whom they were not familiar. The unfamiliarity may have influenced the instructional sessions and consequently the results of the study. For example, the time spent becoming acquainted with the teacher may have delayed the acquisition of the strategy for some subjects.

Implications of the Study

While mental visual imagery may be a spontaneous heuristic used by some students to aid in the comprehension of prose, other students may need instruction to encourage its development and use. As in all skill improvement, instruction and practise are likely to increase the effectiveness of the strategy, even for those who image spontaneously. Therefore, well defined mental visual imagery programs of instruction could promote the improved comprehension of prose text for most readers.

The results of this investigation suggest that an effective visual imagery component could be incorporated into most reading comprehension curricula with relative ease. Among the elements included in a well designed reading comprehension curriculum are refinement of verbal, graphic (writing and drawing), and motor skills. Each of these skills alone or in combination with others would be complemented by visual imagery instruction which in turn would produce a well integrated multiskill approach to reading comprehension development. The nature of visual imagery suggests a creative approach to comprehension improvement. Creative writing and drawing, creative verbalization through oral description and explanation, poetry and drama, etc. and creative movement could be enhanced through visual imagery instruction. In this symbiotic relationship, adeptness in visual imagery would be further developed into a more potent strategy for use in the comprehension of prose.

Suggestions for Further Research

The following suggestions are made for further research into the effects of mental visual imagery on prose comprehension.

1. There is a need for research leading to the design of mental visual imagery curricula that will produce optimum development of an imaging strategy in all readers.

2. Further to the above research, there is a need for investigation into methods and procedures for the integration of an imagery component into the reading comprehension curricula that will complement all facets of skill development (e.g. verbal, graphic, motoric) and

provide maximum reading comprehension achievement.

3. There is a need for longitudinal investigation into the effects of mental visual imagery instruction beginning at the kindergarten level and continuing throughout the entire reading comprehension instructional program to which a student is exposed in formal education.

4. There is a need to investigate teachers' attitudes toward mental visual imagery and its incorporation into the reading comprehension program. Results of such investigation may indicate a need for teacher familiarization and training in the use of the strategy before it can be successfully incorporated into a reading comprehension curriculum.

5. There is a need to further explore the range of comprehension skills influenced by visual imagery instruction and how best that instruction can refine these skills.

6. There is a need for further research to determine if different kinds of learners (e.g. adequate decoders/low comprehenders) are specifically benefitted by mental visual imagery instruction, and if so, what methods of imagery instruction most particularly suit their needs.

Concluding Statement

The importance of visual imagery in learning and memory has long been debated. This study investigated the effect of mental visual imagery instruction on the prose learning and information retention of fourth grade students. The results indicate that visual imagery instruction had a significant effect on prose comprehension through the

improvement of synthesizing and summarizing processes. Mental visual imagery was also found to enhance the retention of information over time.

Because of the complexity of the elements involved in this study (e.g. mental visual imagery, comprehension, and reading instructional programs), much research is required to expose the potential effect of visual imagery in classroom reading comprehension instruction.

The results of the investigation provided one piece of evidence toward an affirmative answer to the question posed by Durkin (1978) "Is reading comprehension teachable?" The indications are that mental visual imagery instruction fostered a significant improvement in the reading comprehension achievement of the experimental subjects who participated in this study.

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APPENDIX A

COMPREHENSION CATEGORIES FOR PROTOCOL ANALYSIS (Fagan, in press)

Comprehension Categories

A. Text Exact

This category includes information from the text in its exact form or with minimal variations. It is assumed that this information was stored in rote fashion or is automatically constrained by other information and is "reproduced" in a similar state.

A1. Verbatim Recall

The information is a direct recall of the lexical items of the text.

Text: The boys were late for school.

Protocol: The boys were late for school.

Substitution of a determiner, a verb form or a function word which does not change the meaning of the unit will also be placed in this category.

Text: He chased the animal.

Protocol: He chased an animal.

Text: People were waiting at the door.

Protocol: People were waiting by the door.

Text: The student had been absent many times.

Protocol: The student was absent many times.

A2. Partial Recall

A significant concept(s) (noun, verb, attribute) is/are omitted in the verbatim recall.

Text: After robbing the store, the convicts raced for their car.

Protocol: The convicts raced for their car.

Text: The children had never seen such a tiny colt.

Protocol: The children had never seen such a colt.

This category would also include fragmented units which are not mazes and although not semantically complete do indicate that the reader has noted and attempted to retrieve concepts which continue the story line.

Text: The stranger told him to follow his advice and put his lines at the spot indicated.

Protocol: The stranger told him...that he would put...all his lines...

B. Text Specific

In this category is placed information recalled that has specific references in the text. The reader may have "transformed" some of this information by reordering or substituting lexical items.

B1. Substitution of Pronouns

A pronoun is used in place of a noun when the noun referent is present elsewhere within the text. All other items in the unit are verbatim.

Text: People were very kind to the stranger.

Protocol: They were very kind to the stranger.

Text: The truck went off the road about one half mile from the settlement.

Protocol: It went off the road about one half mile from the settlement.

B2. Synonymy of Elements

The operational definition of synonymy is context dependent and may refer to (a) substitution of one word for another so that semantic and grammatical features are preserved, (b) the

sequencing of lexical items from a unit such as the preposing of prepositional phrases or substituting an active for a passive, and (c) a paraphrase of the original unit which in the subjective opinion of the scorer has the same conceptual referents and has definite correlates in the text unit.

Text: fish

Protocol: salmon

Text: The house was on fire.

Protocol: The house is burning.

Text: In twos and very slowly the mourners walked in procession.

Protocol: The mourners walked in procession very slowly and in twos.

Text: He said good night and went to bed.

Protocol: He decided to call it an evening and said good night.

C. Text Entailed

The information retrieved is (a) a paraphrase of or synonymous with the information input, but the unit of recall includes information from more than one unit of input, or (b) a superordinate statement subsuming information from more than one text unit. It may be assumed that at the time of comprehending the reader "constructed" information and may still "transform" it at the point of recall.

C1. Synthesis

A synthesis statement is (i) a compilation of at least two units of information. It may not contain either of the specific units summarized but may be expressed in a hierarchial or superordinate category or by a label generalizing the events summarized, such as

a main idea, theme, or moral.

Text: He quickly raced to the landing, stripped off his clothes and jumped into the icy water to rescue the frightened little boy.

Protocol: He did a very brave deed.

Text: While visiting her Aunt Lizzie at the farm last weekend, Teri helped harvest some carrots, peas, zucchini and tomatoes.

Protocol: Last weekend, Teri helped her Aunt harvest some vegetables.

C2. Summary

A statement is a summary if it relates information from at least two units in the text in an embedded form, that is some of the lexical items or units of information are deleted during this process. In summarizing the exact words or their synonyms may be used.

Text: She jumped into the icy water. She was trying to save the swimmer who was in trouble.

Protocol: She jumped into the icy water to save swimmer in trouble.

Text: The stranger pitied the man. He had tried to help but had not been very successful. The stranger felt deep remorse but knew that the man would have to settle his own problems without outside interference. The stranger stared quietly as the man walked slowly away.

Protocol: The stranger pitied the man who walked slowly away.

D. Text Experiential

This information is added by the reader to fill in gaps in the text data. The reader is "reconstructing" information based on prior knowledge which may be of world events such as rodeo, or from having read or listened to other texts.

D1. Inference

An inference may include either a logical reasoning or an instantiation, that is, the filling in of information suggested by the text information but not specified. The latter is often referred to as a pragmatic inference and may be stated in a contradictory form and still make a plausible statement.

Text: John and Bill left for school at the same time and walked at the same rate. But Bill lived several blocks farther away from the school than John. John just reached the school on time. He hoped that Bill would still be able to play ball that evening.

Protocol: (Logical): Bill was late for school.

Text: The mother bundled the children in their parkas, scarves and mittens. She was sure they all had a hot lunch as they left for school.

Protocol: (Pragmatic): It was a cold day.

(Contradiction: It was not a cold day. Perhaps the mother was mentally deranged).

D2. Case Related Information

This includes the expansion of permissible sequences that are assumed extensions of a unit of information in the text. This subcategory describes appropriate prior knowledge of similar content.

Text: Ground corn.

Protocol: Ground corn with a rock.

Text: The captain climbed the mast of the distressed ship and signalled for help.

Protocol: The captain climbed the mast of the distressed ship and signalled for help with his flag.

Text: Used for etching.

Protocol: Used for the etching of drawings.

D3. Experiential Intrusions

This information is related to the theme of the text passage but is not specifically suggested by a particular unit in the text. It does not convey the text information but is an addition of information from the reader's background.

Text: The little boy had disobeyed his mother. She had told him to wait by the car while she went back to the store for the other bag of groceries. Now she could not find him anywhere.

Protocol: One time I saw this woman looking everywhere for her little boy. He went up the escalator when she wasn't looking.

D4. Storyline Additions

These units include additions to the information within the storyline. The origin of these additions appears to be based on the reader's experience with stories and the kinds of goals or actions which are appropriate in a particular context and thus are predictable from the story information. Also included are expressions that

indicate saying, thinking, etc. which are not specifically stated in the text. These are not inferences since they are not immediately constrained by a specific part of the text.

Text: (describing a character's actions that led up to making a decision).

Protocol: He thought he would catch the next train and finally settle the matter completely.

Text: The stranger saw that the man was weak and finally dug a hole through the ice for him.

Protocol: The man said "I am not able to dig the hole." But the stranger said "You got to keep trying and trying." The man said "I just can't do it."

E. Text Erroneous

The protocol units involve the use of text information which the reader has processed incorrectly either at the time of comprehending or at production of the recall.

E1. Errors in Dates and Proper Names

These errors constitute memory errors or are due to lack of attention to the text. The appropriate slot is there but is inaccurately filled.

Text: Sir Wilfred Laurier

Protocol: Sir Wilfred Bennett

Text: 1864

Protocol: 1872

E2. Erroneous Expansions/Additions

These units (i) separate attribute/argument phrases into units that

are conceptually wrong, (ii) expand a unit of information in an erroneous way (D2.), or add information that is incorrect in terms of world knowledge of the events mentioned, or is contradictory with information in the text. These may be due to lack of experience with the content and/or the ambiguity of the text.

Text: They ground corn.

Protocol: They ground corn by heating it.

Text: The lobster's claws.

Protocol: The lobster claws.

E3. Inaccurate/Incorrect Synthesis

Information from different units of the text is (i) designated by an inaccurate superordinate referent, or (ii) is generalized in a way which does not convey the gist of the passage.

Text: We shouldn't always knock computers when they seem to make an error on our accounts. Granted we might be upset when our balance is nil and the computer still insists that we send a check for $40.00. However, if computers were assigned to do the many menial tasks of administrative affairs and leave more time for humans to use their intelligence to solve the more significant problems, then computers and humans would be compatible and would coexist in harmony.

Protocol: Computers are frustrating.

Text: While visiting her Aunt Lizzie at the farm last weekend, Teri helped harvest some carrots, peas, zucchini and tomatoes.

Protocol: Last weekend Teri helped her Aunt harvest some fruit.

E4. Inaccurate/Incorrect Summary

In combining information the reader confuses information about a particular referent.

Text: As the man was scraping snow off the ice he saw someone standing beside him. The man said to the stranger "I don't think I can finish visiting my lines because I am so cold and hungry." The stranger said he would help. He dug new holes for the man and also showed him where to get caribou.

Protocol: A stranger came along. He helped the man dig holes through the ice and then they saw a caribou herd go by.

Text: Mrs. Gray sat down to watch the TV announcer on her weekly show about gardening.

Protocol: Mrs. Gray sat down to watch the TV announcer on his weekly show about gardening.

Text: The dogs lay down and refused to move. The man dragged the sled all the way to the cabin.

Protocol: The dogs dragged the sled to the cabin.

E5. Faulty Inference

The reader draws an incorrect inference from the information given in the text.

Text: Mrs. Gray knew it was two o'clock because she could hear Henry, her parrot squawking. He wanted to watch his favorite TV program. But Mrs. Gray thought that too much TV was bad for Henry's eyes so she told him to rest instead. He squawked even louder so she finally turned on the TV set. After Henry's show was over, she stayed to watch a show on cooking.

Protocol: Mrs. Gray came in from the garden to watch her TV show.

APPENDIX B

LESSON STORIES

A Trip[1]

It was Saturday morning. Eddie and Frank wanted to visit the airport to watch the airplanes land and take off. It was eleven miles to the airport so they decided to ride their bicycles. They each packed some sandwiches for lunch.

They did not know the way, but there were many signs along the road so they were not worried. On the way they passed a cattle ranch, and they saw an owl sleeping in a pine tree.

They rode for about an hour when Eddie suddenly hit a bump on the edge of the road. He tumbled to the ground. Eddie's leg ached a little. It was not serious, but they discovered Eddie's bicycle had a flat tire.

Eddie and Frank decided to return home. They took turns riding Frank's bicycle and pushing Eddie's

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[1] Robert McCracken, Standard Reading Inventory, Oregon: Klamath Printing Co., 1966.

The Great Feast[1]

The long, colorfully painted canoe, paddled by slaves, glided swiftly through the water. At the front of the canoe a man in a bear costume danced about, tossing his head and waving his arms. At the back of the canoe, wrapped in fine blankets, sat an Indian chief, his wife, and their little boy.

The boy was excited. He and his parents were going to a great gift-giving feast to be held by the chief of another village. The feast was in honor of the raising of the chief's new totem pole. This did not happen often for it was tremendously expensive to give a feast of this kind.

Years might be spent preparing for such a feast. All of the people in the village of the chief who gave the feast had to help. Large amounts of food had to be stored for the feast lasted for days. But most important of all were the gifts: blankets, boxes full of fish oil or salt, furs and other things.

Then at the feast, the chief would give all the gifts away! He might even destroy some just to show how rich he was. A really great chief might give away almost all he owned. The more he gave away, the more honor and respect he gained. And all the inhabitants of his village would share in his honor and respect because they had helped to give the great feast.

The boy watched as the canoe headed toward a strip of land in the distance. This was where the feast was to be held. Before long the boy saw several tall poles sticking up. The roofs of the houses came into view. The houses stood in a row on the beach. Behind the narrow beach,

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[1] William Nault (ed.), The Childcraft Annual. Chicago, Ill.: World Book, 1980.

tall fir trees covered the land.

A number of canoes from other villages were also heading toward the beach. Other guests came over land on horseback. Each of these families brought a pack horse to carry home all their valuable gifts. Of course everyone invited to the feast had taken great care to be on time. To be late was to insult the chief giving the feast.

The boy's father ordered his slaves to paddle the canoe to a place behind the others. He was a young man and had been chief for only two years. All the men in the other canoes were older more powerful chiefs. It would not be proper for him to land before any of them for this would show a lack of respect. Such an insult might cause a war!

When the canoe finally landed, the boy's father, then his mother, then the boy himself, stepped out very slowly and solemnly. The slaves followed with the family belongings - bowls, spoons, baskets, finely carved boxes for holding fish oil or salt, sleeping blankets and other items. The slaves then returned to the canoe, pulling it up on the sandy shore, tipping it over to provide drainage so the canoe would be dry for the return trip home.

A relative of the chief who was giving the feast greeted the boy's father. Presents were handed out at once. The family's bowls were filled with good things to eat. Slaves filled the beautifully carved boxes with fish oil in which to dip their food. The boy's basket was filled with berry cakes. But he would find that this was only the beginning. He and his parents would receive many more things. And they would have so much food they wouldn't be able to eat it all.

Together the family walked solemnly toward the feast giver's house to meet him. The great chief and wife stood beside the door. The chief

was wrapped in a beautiful blanket decorated with emblems of his fame. On his head he wore a special head-dress of ermine tails. He greeted the young chief graciously. The boy's father was very respectful in return. The great chief's wife greeted them with a special smile, for the young chief was one of her relatives.

When he entered the house, the boy could hardly believe his eyes. Never had he seen so much food and wealth! Huge boxes of fish oil and piles of blankets and fur robes lined the wall. And the smell of caribou meat, and smoked salmon, chunks of roasting deer, and baskets of berries and tasty roots made his mouth water. There was even a copper - one of the flat pieces of decorated copper worth thousands of blankets!

For the rest of the day the boy and his parents spent their time meeting the other guests, listening to singers, watching the dancers and eating. The merriment went on into the night with everyone grouped around the blazing fire in the great chief's house. Once the boy almost shouted with delight when the chief had a slave throw a whole box of costly fish oil onto the fire! The flames shot up almost to the roof. How wealthy the chief must be to burn up so much fish oil!

APPENDIX C

LESSON PLANS

Visual Imagery Lesson #1

Major Objective: Each child will generate mental visual images of the events and actions in the story to which he listens.

Minor Objective: Each child will describe a minimum of two images that are valid interpretations of the material heard. The description will include interactive situations.

1. Introductions.

2. Purpose: Explain the program.

   I am working with Mrs. Lloyd to help children better understand and remember what they read.

   One method of understanding and remembering involves concentrating on getting pictures in one's head of what has been read.

   Who does that when they hear a story or read? (elaborate if necessary).

   How does it help?

   - if you can see a picture in your mind of what is happening can you understand it better?
   - does it help you to make sense of what is read?

   Concentrating on making pictures in your head can help you to remember stories longer. How? Why?

   - You can close your eyes and get the picture back again. The picture will help you to remember what happened in the story.

3. The method we will use to understand and remember a story is to concentrate and make pictures in our heads. To concentrate we must be relaxed, so let's relax. Find a personal space and stretch out or sit and close your eyes. Take a deep breath and let it out slowly and relax. Let your whole body relax, your toes, legs, stomach and chest, neck and arms - relax. Feel how good it is just to relax. Now try to think of your favorite place - the place you like best to be in the whole world. Thank about that place -- pretend you are there. Can you see it in your mind? What is it like? If it's a room, can you see the furniture and everything that's happening in the room? How do you feel? If it's outside, are there trees? Are they moving in the wind? What else do you see? What's happening in your favorite place? Are you alone or are there people or animals there? Is your body relaxed? How do you feel? What's happening in your favorite place? Now, would you slowly open your eyes, stay relaxed and be prepared to tell us a bit about what happened in your favorite place?

4. Now I'm going to read a story to you and I would like you to listen carefully, concentrate and get a picture in your mind of what happens in the story. Try to concentrate just like you did when you made a picture in your mind of your favorite place. Relax, close your eyes and try to make pictures in your mind of what happens in this story. Then we'll talk about what you saw.

5. Read story in parts and discuss.

   The long, colorfully painted canoe, paddled by slaves, glided swiftly through the water. At the front of the canoe, a man in a bear costume danced about, tossing his head and waving his arms. At

the back of the canoe, wrapped in fine blankets, sat an Indian chief, his wife and their little boy.

Discussion:

Who would like to tell us first what picture you saw in your mind as I read the story?

Elicit the following information:

(a) How did the canoe move through the water? (glide over calm water or roll with the waves, etc.).

(b) How many slaves, where did they sit, were they paddling quickly or slowly? Demonstrate the strokes.

(c) What was the man doing at the front of the boat, why? Description of the dance?

(d) How was the family situated at the back of the boat? Who was sitting where? Were they sitting quietly? Were they moving, talking, etc. How?

(e) Review the dance scene.

The boy was excited. He and his parents were going to a great gift-giving feast to be held by the chief of another village. The feast was in honor of the raising of the chief's new totem pole. This did not happen often for it was tremendously expensive to give a feast of this kind.

Years might be spent preparing for such a feast. All of the people in the village of the chief who gave the feast had to help. Large amounts of food had to be stored, for the feast lasted for days. But most important of all were the gifts - blankets, boxes full of fish oil or <u>salt</u>, furs, and other things.

Discussion:

(a) How did the chief destroy the gifts?

(b) What actions show honor and respect?

(c) Discuss meaning of inhabitants.

(d) Review scene of chief destroying gifts and why.

The boy watched as the canoe headed toward a strip of land in the distance. This was where the feast was to be held. Before long the boy saw several tall poles sticking up. The roofs of the houses came into view. The houses stood in a row on the beach. Behind the narrow beach, tall fir trees covered the land.

A number of canoes from other villages were also heading toward the beach. Other guests came overland on horseback. Each of these families brought a pack horse to carry home all their valuable gifts. Of course everyone invited to the feast had taken great care to be on time. To be late was to insult the chief giving the feast.

Discussion:

(a) What did the boy see as they approached land?

(b) How did the people arrive? Discuss action.

(c) Discuss the use of pack horses.

(d) Review the arrival scene. How might they be greeted?

The boy's father ordered his slaves to paddle the canoe to a place behind the others. He was a young man and had been chief for only two years. All the men in the other canoes were older more powerful chiefs. It would not be proper for him to land before any of them for this would show lack of respect. Such an insult might cause a war!

Discussion:

(a) What did the canoes do when they were lining up to land? Why?

(b) Discuss the meaning of lack.

(c) Review scene of canoes lining up.

When the canoe finally landed, the boy's father, then his mother, then the boy himself, stepped out, very slowly and solemnly. The slaves followed with the family belongings - bowls, spoons, baskets, finely carved boxes for holding fish oil or salt, sleeping blankets and other items. The slaves then returned to the canoe, pulling it up on the sandy shore, tipping it over to provide drainage so the canoe would be dry for the return trip home.

Discussion:

(a) How did the people get out of the canoe? Describe the scene.

(b) Discuss the meaning of drainage.

(c) What happened when the canoe landed? What did the slaves do? Describe the actions.

A relative of the chief who was giving the feast greeted the boy's father. Presents were handed out at once. The family's bowls were filled with good things to eat. Slaves filled the beautifully carved boxes with fish oil in which to dip their food. The boy's basket was filled with berry cakes. But he would find that this was only the beginning. He and his parents would receive many more things. And they would have so much food they wouldn't be able to eat it all.

Together the family walked solemnly toward the feast giver's home to meet him. The great chief and his wife stood beside the door. The chief was wrapped in a beautiful blanket decorated with emblems of his fame. On his head he wore a special head-dress of ermine tails. He greeted the young chief graciously. The boy's father was very respectful in return. The great chief's wife greeted them with a special smile, for the young chief was one of her relatives.

Discussion:

(a) How were the boy's family greeted? What happened?

(b) What did the boxes look like? What was the food?

(c) Describe the greeting between guests and hosts. What is a gracious greeting? How did the boy's father show respect?

(d) Review the scene of the family walking toward the chief's house.

When he entered the house the boy could hardly believe his eyes. Never had he seen so much food and wealth! Huge boxes of fish oil and piles of blankets and fur robes lined the wall. And the smell of caribou meat, and smoked salmon, chunks of roasting deer, and baskets of berries and tasty roots made his mouth water. There was even a copper - one of the flat pieces of decorated copper worth thousands of blankets!

For the rest of the day the boy and his parents spent their time meeting the other guests, listening to singers, watching the dancers, and eating. The merriment went on into the night with everyone grouped around the blazing fire in the great chief's house. Once the boy almost shouted with delight when the chief had a slave throw a whole box of costly fish oil onto the fire! The flames shot up

almost to the roof. How wealthy the chief must be to burn up so much fish oil!

Discussion:

(a) How did the guests greet one another? Describe the scene.

(b) What did the dancers do? How did they dance?

(c) Describe what happened when the slave threw the oil on the fire. Why did he do it?

That's the end of the story and now would you quickly think about the story - choose your favorite part and then close your eyes and concentrate on that part and get as clear a picture as you can of the story so that you can see what's happening and why it's happening.

From now on whenever you read at school, at home, or anywhere will you concentrate on getting a picture in mind of what is happening in the story so you will be able to understand and remember it.

Visual Imagery Lesson #2

Major Objective: Each child will generate mental visual images of the events and actions in the story he reads silently.

Minor Objective: From the events imaged each child will sketch four episodes of the story.

1. Reintroduce self.

2. Purpose: Review the program and the purpose of imaging (understanding and remembering).

   Who practised getting pictures in your head while you were concentrating and reading since I saw you yesterday? What did you have to do to make images? How can imaging help you when you read? Close your eyes and try to see what happened in yesterday's story.

   Discuss the interactive images.

3. I am going to give you a story to read silently and as you read would you concentrate and form pictures in your head of what is happening in the story. Remember to relax and concentrate on what happens in the story to get clear pictures in your mind. If you have questions about the words please ask me for help.

4. When you have finished reading, please take one of these papers. On the paper there are four boxes. Would you sketch four events that you imaged in your mind when you read the story. Don't be concerned about your drawing because we won't have enough time to make good pictures. If you want to draw stick people that's fine. You'll have just a few minutes for each box. Remember your images of what is happening and draw them in the boxes.

5. Would you choose one of the imaged pictures that you drew and tell us what is happening in the picture.

6. Will you continue to practise concentrating and forming pictures in your head whenever you read and when Mrs. Lloyd comes back and asks you to read stories for her be certain to do it then. Try to form clear images. Remember what I've said about concentrating on what happens in the story and making pictures in your head of those events in order to help you better understand and remember what you read.

Control Lesson #1

Major Objective: To provide an instructional experience similar to that of the imagery group but excluding the visual imagery feature.

Minor Objective: Each child will participate in discussion of at least two questions posed.

1. Introductions.

2. Purpose: Explain the program.

   I am working with Mrs. Lloyd to help children better understand and remember what they read.

   One method of understanding and remembering what is read is to concentrate. Who will tell us what concentrate means? (pay close attention).

   Do you do that when you read?

   How does it help?

   - if you concentrate does it help you to understand better?

   - does it help you to make sense of what is read?

   Concentrating can help you to remember stories longer. How? Why?

3. The method we will use to understand and remember a story is to concentrate and to concentrate we must be relaxed, so let's relax. Find a personal space and stretch out or sit and close your eyes. Take a deep breath and let it out slowly and relax. Let your whole body relax, your toes, legs, stomach and chest, neck and arms - relax. Feel how good it is just to relax. Concentrate on relaxing. How do you feel? Is your body relaxed? Just concentrate on relaxing your body. Now would you slowly open your eyes, stay

relaxed and be prepared to tell us a bit about how it feels to concentrate on relaxing. Discussion regarding concentrating.

4. Now I'm going to read a story to you and I would like you to listen carefully and concentrate on what happens in the story. Try to concentrate just like you did when you relaxed. Then we'll talk about what you hear in the story.

5. Read story in parts and discuss.

The long, colorfully painted canoe, paddled by slaves, glided swiftly through the water. At the front of the canoe, a man in a bear costume danced about, tossing his head and waving his arms. At the back of the canoe, wrapped in fine blankets, sat an Indian chief, his wife and their little boy.

Discussion:

Who would like to tell us what the story is about and what is happening?

(a) Where were the people?

(b) What were the slaves doing?

(c) What was the man doing at the front of the boat?

(d) Who was sitting at the back of the boat?

The boy was excited. He and his parents were going to a great gift-giving feast to be held by the chief of another village. The feast was in honor of the raising of the chief's new totem pole. This did not happen often for it was tremendously expensive to give a feast of this kind.

Years might be spent preparing for such a feast. All of the people in the village of the chief who gave the feast had to help. Large amounts of food had to be stored, for the feast lasted for days.

But most important of all were the gifts - blankets, boxes full of fish oil or salt, furs and other things.

Discussion:

(a) What is a totem pole? Why did they have them?

(b) What did the people do to get and store the food?

(c) Why was salt valued? (It's importance in the diet of man and animals).

Then at the feast, the chief would give all the gifts away! He might even destroy some just to show how rich he was. A really great chief might give away almost all he owned. The more he gave away, the more honor and respect he gained. And all the inhabitants of his village would share in his honor and respect because they had helped to give the great feast.

Discussion:

(a) Why did the chief destroy the gifts?

(b) Why did they show honor and respect?

(c) Discuss the meaning of inhabitants.

The boy watched as the canoe headed toward a strip of land in the distance. This was where the feast was to be held. Before long the boy saw several tall poles sticking up. The roofs of the houses came into view. The houses stood in a row on the beach. Behind the narrow beach, tall fir trees covered the land.

A number of canoes from other villages were also heading toward the beach. Other guests came overland on horseback. Each of these families brought a pack horse to carry home all their valuable gifts. Of course everyone invited to the feast had taken great care to be on time. To be late was to insult the chief giving the feast.

Discussion:

(a) What did the boy see as they approached land?

(b) How did the people arrive?

(c) Discuss the use of pack horses.

The boy's father ordered his slaves to paddle the canoe to a place behind the others. He was a young man and had been chief for only two years. All the men in the other canoes were older more powerful chiefs. It would not be proper for him to land before any of them for this would show lack of respect. Such an insult might cause a war!

Discussion:

(a) What did the canoes do what they were lining up to land?

(b) Discuss the meaning of lack.

(c) Why did the canoes line up?

When the canoe finally landed, the boy's father, then his mother, then the boy himself, stepped out, very slowly and solemnly. The slaves followed with the family belongings - bowls, spoons, baskets, finely carved boxes for holding fish oil or salt, sleeping blankets and other items. The slaves then returned to the canoe, pulling it up on the sandy shore, tipping it over to provide drainage so the canoe would be dry for the return trip home.

Discussion:

(a) How did the people get out of the canoe?

(b) Discuss the meaning of drainage.

(c) What happened after the canoe landed.

A relative of the chief who was giving the feast greeted the boy's father. Presents were handed out at once. The family's bowls were

filled with good things to eat. Slaves filled the beautifully carved boxes with fish oil in which to dip their food. The boy's basket was filled with berry cakes. But he would find that this was only the beginning. He and his parents would receive many more things. And they would have so much food they wouldn't be able to eat it all.

Together the family walked solemnly toward the feast giver's home to meet him. The great chief and his wife stood beside the door. The chief was wrapped in a beautiful blanket decorated with emblems of his fame. On his head he wore a special head-dress of ermine tails. He greeted the young chief graciously. The boy's father was very respectful in return. The great chief's wife greeted them with a special smile, for the young chief was one of her relatives.

Discussion:

(a) Who greeted the boy's family?

(b) What was in the boxes? What was the food?

(c) What is a gracious greeting? How did the boy's father show respect?

When he entered the house the boy could hardly believe his eyes. Never had he seen so much food and wealth! Huge boxes of fish oil and piles of blankets and fur robes lined the wall. And the smell of caribou meat, and smoked salmon, chunks of roasting deer, and baskets of berries and tasty roots made his mouth water. There was even a copper - one of the flat pieces of decorated copper worth thousands of blankets!

For the rest of the day the boy and his parents spent their time meeting the other guests, listening to singers, watching the dancers,

and eating. The merriment went on into the night with everyone grouped around the blazing fire in the great chief's house. Once the boy almost shouted with delight when the chief had a slave throw a whole box of costly fish oil onto the fire! The flames shot up almost to the roof. How wealthy the chief must be to burn up so much fish oil!

Discussion:

(a) How did the guests greet one another?

(b) What did the boy and his family do all day?

(c) Why did the slave throw the oil on the fire?

That's the end of the story and now would you quickly concentrate on the story, choose your favorite part, and remember what it was about.

From now on whenever you read at school, at home, or anywhere will you concentrate on what you read so you will be better able to understand and remember it.

Control Lesson #2

Major Objective: To provide an instructional experience similar to that of the imagery group but excluding the visual feature.

Minor Objective: From events in the story concentrated upon, each child will sketch four episodes.

1. Reintroductions.

2. Purpose: Review the program and purpose of concentrating (understanding and remembering).

   Who practised concentrating as you were reading since I saw you yesterday? What did you have to do to concentrate? How does concentrating help you when you read? Concentrate now and try to remember what happened in yesterday's story.

   Discuss memories.

3. I am going to give you a story to read silently and as you read would you concentrate on what is happening in the story. Remember to relax and concentrate. If you have questions about the words please ask me for help.

4. When you have finished reading please take one of these papers. On the paper there are four boxes. Would you sketch four events that you concentrated on when you read the story. Don't be concerned about your drawings because we won't have time to make good pictures. If you want to draw stick people that's fine. You'll just have a few minutes for each box. Remember to concentrate and draw what you remember in the boxes.

5. Would you choose one of the pictures that you drew and tell us about it?

6. Will you continue to practise concentrating whenever you read and when Mrs. Lloyd comes back and asks you to read stories for her be certain to do it then. Remember what I've said about concentrating on what happens in a story to help you understand and remember the story better.

APPENDIX D

BACKGROUND INFORMATION OF NONVERBAL IQ, DECODING AND COMPREHENSION ACHIEVEMENT LEVEL, AND AGE OF SUBJECTS RANDOMLY ASSIGNED TO THE EXPERIMENTAL GROUP

TABLE 2.1

BACKGROUND INFORMATION OF NONVERBAL IQ, DECODING AND COMPREHENSION ACHIEVEMENT LEVEL, AND AGE OF SUBJECTS RANDOMLY ASSIGNED TO THE EXPERIMENTAL GROUP

Subject	Sex	Nonverbal IQ[1] Score	Decoding[2] Percentile Score	Comprehension[3] Percentile Score	Chronological Age (April, 1980)
101	M	109	49	78	9 yrs. 07 mos.
103	F	118	65	50	9 yrs. 11 mos.
104	F	120	98	99	10 yrs. 00 mos.
105	F	122	99	96	9 yrs. 08 mos.
108	M	118	54	53	10 yrs. 00 mos.
112	M	104	60	72	9 yrs. 05 mos.
114	F	96	71	25	9 yrs. 07 mos.
115	M	..[4]	74	88	10 yrs. 01 mos.

[1]Canadian Cognitive Abilities Test.

[2]Edmonton Public Schools Elementary Reading Test: Grade Three.

[3]Edmonton Public Schools Elementary Reading Test: Grade Three.

[4]Canadian Cognitive Abilities Test scores not available.

TABLE 2.1 cont'd

BACKGROUND INFORMATION OF NONVERBAL IQ, DECODING AND COMPREHENSION ACHIEVEMENT LEVEL, AND AGE OF SUBJECTS RANDOMLY ASSIGNED TO THE EXPERIMENTAL GROUP

Subject	Sex	Nonverbal IQ Score	Decoding Percentile Score	Comprehension Percentile Score	Chronological Age (April, 1980)
117	M	101	49	10	11 yrs. 00 mos.
120	M	82	44	38	10 yrs. 01 mos.
123	F	92	24	38	10 yrs. 02 mos.
124	F	94	96	90	9 yrs. 01 mos.
125	F	127	92	56	9 yrs. 05 mos.
129	M	87	54	45	9 yrs. 09 mos.
130	M	123	54	50	9 yrs. 11 mos.
131	M	..	08	07	9 yrs. 10 mos.
132	M	87	30	15	9 yrs. 07 mos.
134	F	91	04	08	10 yrs. 08 mos.
135	M	..	09	31	10 yrs. 08 mos.

TABLE 2.1 cont'd

BACKGROUND INFORMATION OF NONVERBAL IQ, DECODING AND COMPREHENSION ACHIEVEMENT LEVEL, AND AGE OF SUBJECTS RANDOMLY ASSIGNED TO THE EXPERIMENTAL GROUP

Subject	Sex	Nonverbal IQ Score	Decoding Percentile Score	Comprehension Percentile Score	Chronological Age (April, 1980)
136	F	90	17	25	9 yrs. 03 mos.
137	F	114	92	97	10 yrs. 01 mos.
138	M	..	48	37	9 yrs. 06 mos.
142	M	86	54	59	9 yrs. 03 mos.
145	F	120	27	29	10 yrs. 00 mos.
149	F	101	49	75	9 yrs. 03 mos.
156	F	103	09	50	9 yrs. 09 mos.

TABLE 2.2

BACKGROUND INFORMATION OF NONVERBAL IQ, DECODING AND COMPREHENSION ACHIEVEMENT LEVEL, AND AGE OF SUBJECTS RANDOMLY ASSIGNED TO THE CONTROL GROUP

Subject	Sex	Nonverbal IQ[1] Score	Decoding[2] Percentile Score	Comprehension[3] Percentile Score	Chronological Age (April, 1980)
202	F	97	65	25	10 yrs. 00 mos.
206	F	108	60	42	10 yrs. 00 mos.
207	M	82	30	23	9 yrs. 08 mos.
209	M	82	20	11	10 yrs. 10 mos.
210	F	101	20	50	10 yrs. 03 mos.
211	M	86	92	84	10 yrs. 04 mos.
213	M	106	54	20	10 yrs. 09 mos.
216	M	113	49	34	10 yrs. 05 mos.

[1]Canadian Cognitive Abilities Test.

[2]Edmonton Public Schools Elementary Reading Test: Grade Three.

[3]Edmonton Public Schools Elementary Reading Test: Grade Three.

TABLE 2.2 cont'd

BACKGROUND INFORMATION OF NONVERBAL IQ, DECODING AND COMPREHENSION ACHIEVEMENT LEVEL, AND AGE OF SUBJECTS RANDOMLY ASSIGNED TO THE CONTROL GROUP

Subject	Sex	Nonverbal IQ Score	Decoding Percentile Score	Comprehension Percentile Score	Chronological Age (April, 1980)
218	M	..[4]	83	45	10 yrs. 00 mos.
221	M	130	71	45	9 yrs. 11 mos.
222	F	99	76	42	9 yrs. 08 mos.
226	F	101	82	72	9 yrs. 11 mos.
227	F	122	82	78	9 yrs. 09 mos.
239	M	80	39	07	9 yrs. 04 mos.
240	M	..	24	13	10 yrs. 10 mos.
241	M	94	30	12	10 yrs. 01 mos.
242	F	83	20	29	9 yrs. 09 mos.
244	F	80	76	66	9 yrs. 05 mos.
246	M	..	34	06	10 yrs. 04 mos.

[4]Canadian Cognitive Abilities Test scores not available.

TABLE 2.2 cont'd

BACKGROUND INFORMATION OF NONVERBAL IQ, DECODING AND COMPREHENSION ACHIEVEMENT LEVEL, AND AGE OF SUBJECTS RANDOMLY ASSIGNED TO THE CONTROL GROUP

Subject	Sex	Nonverbal IQ Score	Decoding Percentile Score	Comprehension Percentile Score	Chronological Age (April, 1980)
247	F	95	17	27	10 yrs. 09 mos.
248	M	..	70	68	9 yrs. 06 mos.
250	F	90	54	42	9 yrs. 08 mos.
251	F	103	60	50	9 yrs. 06 mos.
253	F	115	54	59	9 yrs. 05 mos.
254	F	110	39	56	9 yrs. 09 mos.
255	F	94	20	31	9 yrs. 09 mos.

APPENDIX E

T-TESTS ON IQ, DECODING AND COMPREHENSION SCORES, AND AGE TO ESTABLISH DEGREE OF SIMILARITY BETWEEN THE EXPERIMENTAL AND CONTROL GROUPS

TABLE 3.1

T-TESTS ON IQ, DECODING AND COMPREHENSION SCORES, AND AGE TO ESTABLISH DEGREE OF SIMILARITY BETWEEN THE EXPERIMENTAL AND CONTROL GROUPS

Variable	Number of Cases	Mean	Standard Deviation	Standard Error	T Value	Degrees of Freedom	2-Tailed Probability
Experimental nonverbal IQ	22	103.86	14.34	3.06	1.21	42	0.231
Control nonverbal IQ	22	98.68	13.96	2.98			
Experimental decoding	26	51.15	29.46	5.78	0.05	50	0.963
Control decoding	26	50.81	23.85	4.68			
Experimental comprehension	26	50.81	28.81	5.65	1.52	50	0.134
Control comprehension	26	39.88	22.51	4.41			
Experimental age	26	9.86	0.43	0.09	0.83	50	0.41
Control age	26	9.96	0.48	0.09			

APPENDIX F

PRE-TEST AND POST-TEST PASSAGES (INSTRUMENTS) USED TO MEASURE COMPREHENSION ACHIEVEMENT

Pre-Test Passage: One[1]

FOURTH - ORAL

The Little Beaver (149 words)

The hooting of the horned own was well known to the orphan beaver. It meant no danger to him until one night when he was swimming across an open pool. Out of the night came a silent shadow. The beaver dived as the owl struck. He escaped except for a small cut in his tail.

Later he met the dogs. He had heard them many times. He knew their smell, so these signs did not alarm him. One night he went farther than usual in search of new greens. Two dogs running silently along the side of a hill began barking when they saw the beaver. He headed for the water, but the dogs cut him off.

The stillness was broken by a tumbling howling tangle of beaver and dogs. His heavy coat protected him, and his sharp teeth fought off the dogs long enough for him to escape.

__1. What sound was he used to hearing?

__2. What was the beaver doing one night?

__3. What happened that night? (What did the owl do?)

__4. What happened to the beaver?

__5. Why didn't the dogs frighten the beaver?

__6. Why was he out on land one night?

__7. What did the dogs do when they saw the beaver?

__8. What did the beaver try to do?

__9. What happened?

_10. What saved the beaver?

---

[1] R. McCracken, 1966, Form A, p. 12, Reader level 4.

Pre-Test Passage: Two[1]

FOURTH - SILENT

The Wright Brothers (149 words)

"They ought to stick to bicycles. Bicycles are here to stay and they have to earn a living."

Many of the Wright brothers' customers felt this way in 1901. They brought their bicycles to be repaired and when they came back the bikes were not fixed. Orville and Wilbur were too busy flying kites, watching birds, or tinkering with their latest glider.

"Now that they're putting a motor in the glider we'll never get a bike fixed here," said one man.

The Wright brothers didn't seem to care about their bicycle business. They tinkered and planned, built and planned some more.

No one expected them to succeed. Yet on December 17, 1903 on the cold sands near Kitty Hawk, North Carolina, with only five people to watch, they started the motor. Orville flew down the track and then into the air for twelve seconds. Man had flown an airplane.

__1. What kind of business did the Wright brothers have?

__2. How did many of their customers feel?

__3. Why were some customers annoyed?

__4. What were their (first) names? (credit one)

__5. What did the Wright brothers do instead of repairing bikes?

__6. What did they put in their glider?

__7. How did the Wright brothers feel about their business?

__8. When did they succeed?

__9. Where did they succeed?

_10. How long did the flight last?

---

[1] R. McCracken, 1966, Form A, p. 13, Reader level 4.

Post-Test Passage: One[1]

FOURTH - ORAL

Turtle Eggs (149 words)

Horseshoe Bend is a long shallow pond about a half mile from my home. Two old turtles are among its many inhabitants. They have lived in the pond for many years. No one knows how long.

Every year in June the female snapping turtle leaves the water and takes a short journey. She hunts for a good place to lay her eggs. A turtle likes a sunny spot in sandy soil where there is good drainage. There the eggs will be hatched by the heat from the sun's rays.

When the turtle finds such a place she digs a hole about five inches deep. In it she lays twenty to forty eggs. The eggs are white and round as marbles. They are about one inch thick. When the eggs are all in the hole she covers them carefully and returns to the water without further thought of the eggs.

__1. What is Horseshoe Bend?

__2. Who lived there? (What else?)

__3. How long had the turtles lived there?

__4. What does the female turtle do every year?

__5. What kind of place does she want?

__6. How are the eggs hatched?

__7. Where does a turtle lay her eggs?

__8. How many does she lay?

__9. Describe the eggs.

_10. What does the turtle do after laying the eggs?

---

[1] R. McCracken, 1966, Form B, p. 31, Story #1, Reader level 4.

Post-Test Passage: Two[1]

FOURTH - SILENT

Daniel Boone (149 words)

Daniel Boone led the way through the forest. A dozen men, each leading a pack horse, followed him. They walked as quickly and quietly as possible because they were in savage Indian country. These men were farmers now. But they also knew how to hunt and shoot.

They would not have left their farms except that they needed salt. They had no salt and their farm animals were suffering from lack of it. New settlers had been bringing salt, but no new settlers had arrived for a long time.

Although Daniel was only fifteen years old, the older men trusted him. Daniel had spent two years alone in this wilderness. He was the only one who knew this wild country. He was the only one who knew where the salt springs were. If they were lucky they would get to the salt springs and back without meeting any Indians.

__1. Who was the leader?

__2. Who were on the trip?

__3. How did they go?

__4. What was the danger?

__5. What kind of men were they?

__6. Why were they going?

__7. How did they usually get salt?

__8. How old was Daniel?

__9. Why was he the leader?

_10. What did they hope would happen?

---

[1] R. McCracken, 1966, Form B, Story #2, Reader level 4.

APPENDIX G

EXAMPLES OF ANALYZED RECALL PROTOCOL CATEGORIES

Turtle Eggs[1]

Horseshoe Bend is a long shallow pond about a half mile from my home. Two old turtles are among it's many inhabitants. They have lived in the pond for many years. No one knows how long.

Every year in June the female snapping turtle leaves the water and takes a short journey. She hunts for a good place to lay her eggs. A turtle likes a sunny spot in sandy soil where there is good drainage. There the eggs will be hatched by the heat from the sun's rays.

When the turtle finds such a place she digs a hole about five inches deep. In it she lays twenty to forty eggs. The eggs are white and round as marbles. They are about one inch thick. When the eggs are all in the hole she covers them carefully and returns to the water without further thought of the eggs.

Basic Units

When it's time for the turtle to have her babies, she takes a ~~long~~ ~~no, I mean~~ a short journey (C) up to a sandy place where there's good drainage (B) and she lets her eggs stay there./ They are one inch thick. (A)/ After they are in her little nest, (B) she will cover them up/and without further thought (A) she goes back into the water./ And she will swim to meet her mate. (D)/

Subject #101

Basic structures: 6

Recall Categories:

A Text Exact

---

[1] Robert McCracken, Standard Reading Inventory, 1966, Form B, p. 31, Story #1, Reader Level 4.

B	Text Specific	2
C	Text Entailed	1
D	Text Experiential	1
E	Text Eroneous	0

Daniel Boone[1]

Daniel Boone led the way through the forest. A dozen men, each leading a pack horse, followed him. They walked as quickly and quietly as possible because they were in savage Indian country. These men were farmers now. But they also knew how to hunt and shoot.

They would not have left their farms except that they needed salt. They had no salt and their farm animals were suffering from lack of it. New settlers had been bringing salt, but no new settlers had arrived for a long time.

Although Daniel was only fifteen years old, the older men trusted him. Daniel had spent two years alone in this wilderness. He was the only one who knew this wild country. He was the only one who knew where the salt springs were. If they were lucky they would get to the salt springs and back without meeting any Indians.

Basic Units

C
Daniel Boone was leading about a dozen men through the wilderness./
A A
And the men were farmers/but they knew how to hunt and shoot/~~and every~~
E B
~~thing~~. They rode quietly./ And they tried to go very quickly and very quietly because it was very savage Indian territory./ ~~The men were~~
B
~~farmers~~ and they left their farms because they needed salt./ They all
C
trusted Daniel Boone because ~~he had been~~ - he had lived in the wilderness
B
alone for two years./ He was the only one that knew his way through the wilderness territory./

Subject #104

Basic structures: 8

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[1] Robert McCracken, Standard Reading Inventory, 1966, Form B, p. 32, Story #2, Reader Level 4.

Recall Categories:

A	Text Exact	2
B	Text Specific	3
C	Text Entailed	2
D	Text Experiential	0
E	Text Erroneous	1

APPENDIX H

EXAMPLES OF RECALLED UNITS OF INFORMATION

Total Units of Information

Turtle Eggs

When it's time for the turtle to have her babies/she takes a ~~long journey---no-I-mean-a~~ short/journey/up to a sandy place/where there's good drainage/and she lets her eggs stay there./ They are one inch thick./ After they are in her little/nest/she will cover them up/and without further thought/she goes back into the water./ And she will swim/to meet her mate./

Subject #101

Total Units of Information: 14

Daniel Boone

Daniel Boone was leading/about a dozen/men through the wilderness./ And the men were farmers/but they knew how to hunt/and shoot/and ~~every-thing~~. ~~They-rode-quietly~~./ And they tried to go very quickly/and very quietly /because it was very savage/Indian territory./ ~~The-men-were farmers~~ and they left their farms because they needed salt./ The horses and other animals/were suffering from lack of it./ They all trusted Daniel Boone/because he ~~had-been---he~~ had lived in the wilderness/alone/ for two years./ He was the only one that knew his way through the wilderness territory./

Subject #104

Total Units of Information: 18

APPENDIX I

SIGNIFICANCE TEST OF ONE FACTOR ANALYSIS OF VARIANCE AND COVARIANCE FOR COMPREHENSION ACHIEVEMENT OF FOURTH GRADE EXPERIMENTAL AND CONTROL SUBJECTS ON THE STANDARD READING INVENTORY (McCracken)

TABLE 4.1

SIGNIFICANCE TEST OF ONE FACTOR ANALYSIS OF VARIANCE AND COVARIANCE FOR COMPREHENSION ACHIEVEMENT OF FOURTH GRADE EXPERIMENTAL AND CONTROL SUBJECTS ON THE STANDARD READING INVENTORY (McCracken)

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
Main Effects	47.5392	1	47.5392	4.47233	0.03956[1]
Covariance	297.6887	1	297.6887	28.0055	0.00000
Errors	520.8515	49	10.6296		

[1]Significant at the .05 level ($p < .05$)

APPENDIX J

ANALYSIS OF VARIANCE SUMMARY TABLE FOR FOURTH GRADE EXPERIMENTAL AND CONTROL SUBJECTS' COMPREHENSION PROCESSING AS MEASURED BY THE COMPREHENSION CATEGORIES FOR PROTOCOL ANALYSIS (Fagan)

TABLE 7.1

ANALYSIS OF VARIANCE SUMMARY TABLE FOR FOURTH GRADE EXPERIMENTAL AND CONTROL SUBJECTS' COMPREHENSION PROCESSING AS MEASURED BY THE COMPREHENSION CATEGORIES FOR PROTOCOL ANALYSIS (Fagan)

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
Text Exact	0.029	1	0.029	0.019	0.891
Text Specific	9.151	1	9.151	1.328	0.225
Text Entailed	6.940	1	6.940	3.462	0.069
Text Experiential	0.103	1	0.103	0.068	0.796
Text Erroneous	2.282	1	2.282	0.871	0.355